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-	58	(digital adj1 camera$1) same integrated same (computer) same (bus)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2004/04/15 09:42
-	714	(camera$1) with integrated with (computer)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2004/04/15 09:43
-	45	((camera$1) with integrated with (computer)) same (bus or serial)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2004/04/15 09:43
-	47	camera adj1 phone	USPAT; US-PGPUB; EPO; JPO; DERWENT	2004/04/15 09:47
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-	480	(samsung or nokia or motorola or LG or Sony or Ericsson) and phone$1 and integrated and camera$1	USPAT; EPO; JPO; DERWENT	2004/04/15 09:52
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-	13	(camera adj1 module) and (electronic adj1 device)	USPAT; EPO; JPO; DERWENT	2004/04/15 10:02
-	3992	(camera) and (electronic adj1 device)	USPAT; EPO; JPO; DERWENT	2004/04/15 10:02
-	1015	(camera) and (electronic adj1 device) and integrated	USPAT; EPO; JPO; DERWENT	2004/04/15 10:02
-	5322	integrated near10 camera$1	USPAT; EPO; JPO; DERWENT	2004/04/15 10:03
-	19148	serial near4 bus	USPAT; EPO; JPO; DERWENT	2004/04/15 10:03
-	127	(integrated near10 camera$1) and (serial near4 bus)	USPAT; EPO; JPO; DERWENT	2004/04/15 10:26
-	2	cardcam	USPAT; EPO; JPO; DERWENT	2004/04/15 10:44
-	15674	710/$.ccls.	USPAT; EPO; JPO; DERWENT	2004/04/15 10:44
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-	793	710/$.ccls. and PCMCIA	USPAT; EPO; JPO; DERWENT	2004/04/15 10:59
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-	2	5475441.pn.	USPAT; EPO; JPO; DERWENT	2004/04/15 11:00
-	248	PCMCIA near4 serial	USPAT; EPO; JPO; DERWENT	2004/04/15 11:06
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United States Patent [19]

Sanemitsu

[11] Patent Number: 5,708,853

[45] Date of Patent: Jan. 13, 1998

[54] **IC CARD HAVING CAMERA, MICROPHONE, AND MODEM FOR USE IN INFORMATION PROCESSORS**

[75] Inventor: **Yoshikado Sanemitsu**, Tokyo, Japan

[73] Assignee: **Mitsubishi Denki Kabushiki Kaisha**, Tokyo, Japan

[21] Appl. No.: **561,238**

[22] Filed: **Nov. 21, 1995**

[30] **Foreign Application Priority Data**

Jul. 24, 1995 [JP] Japan 7-187258

[51] **Int. Cl.**[6] **C06F 13/00**; C06F 19/00

[52] **U.S. Cl.** **395/893**; 348/376; 361/737

[58] **Field of Search** 395/892, 893; 361/737, 749; 345/156; 348/373, 376

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Primary Examiner—Dinh C. Dung

Attorney, Agent, or Firm—Birch, Stewart, Kolasch & Birch, LLP

[57] **ABSTRACT**

An IC Card includes an image input device and an acoustic input device. A transmission controller transmits electrical signals received from the image input device or the acoustic input device to a telephone or communication line, or transmits signals received from the communication line through a first connector to a terminal such as a personal computer. A frame supports the image input device, and the acoustic input device, the transmission controller, while a panel fixed to the frame encloses the image input device, the acoustic input device and the transmission controller. Another type of IC card has a frame with a main body and an extension connected thereto. The extension encloses the image input device and the acoustic input device. In a modified IC card, at least one of the image input device and the acoustic input device includes a rotatable connecting member so that the direction of the device can be set in a wide range.

18 Claims, 8 Drawing Sheets

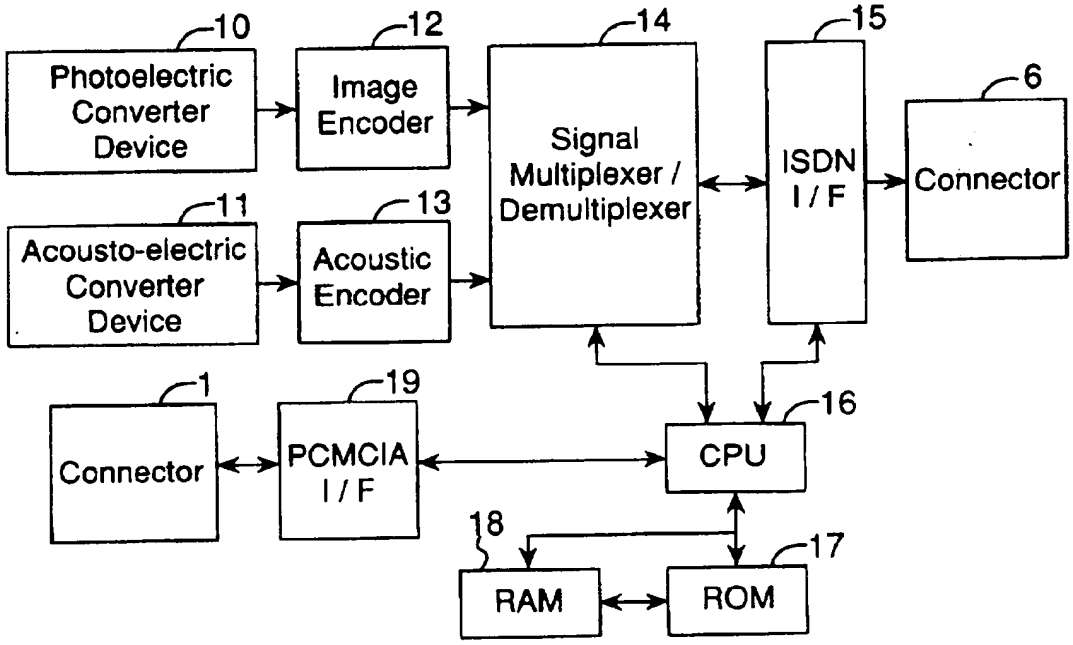
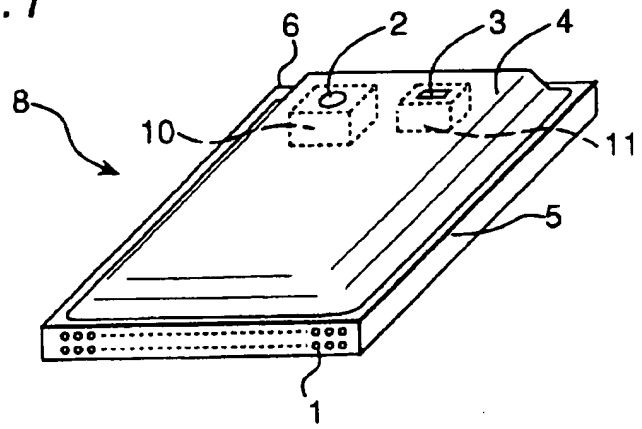


Fig.1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8
10
11
5
1

Fig.2

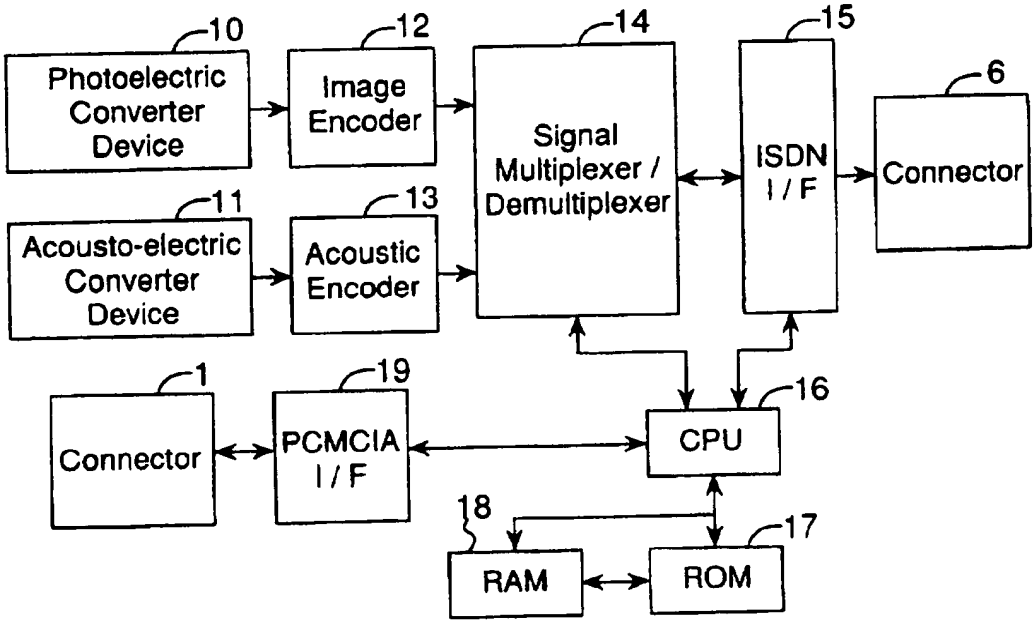

10
Photoelectric Converter Device
12
Image Encoder
14
Signal Multiplexer / Demultiplexer
15
ISDN I / F
6
Connector
11
Acousto-electric Converter Device
13
Acoustic Encoder
1
Connector
19
PCMCIA I / F
16
CPU
18
RAM
17
ROM

Fig.3

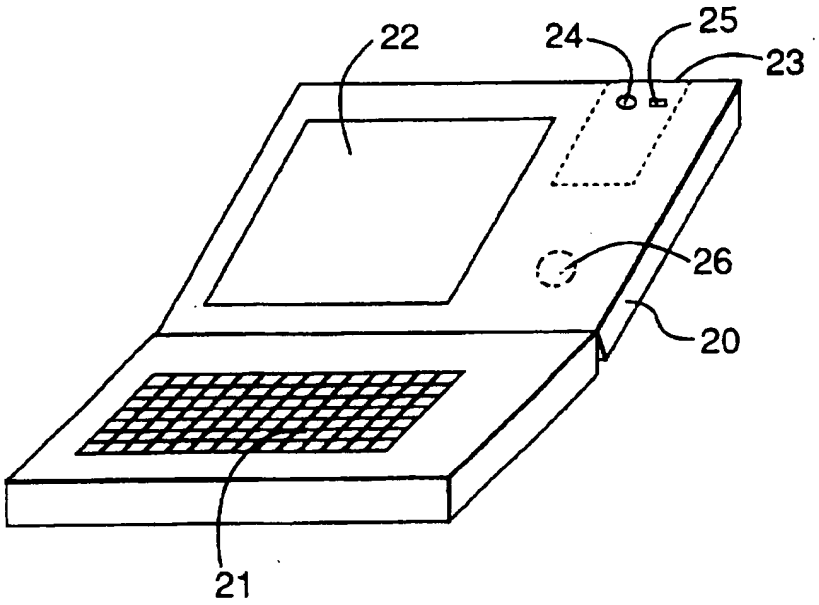


Fig.4

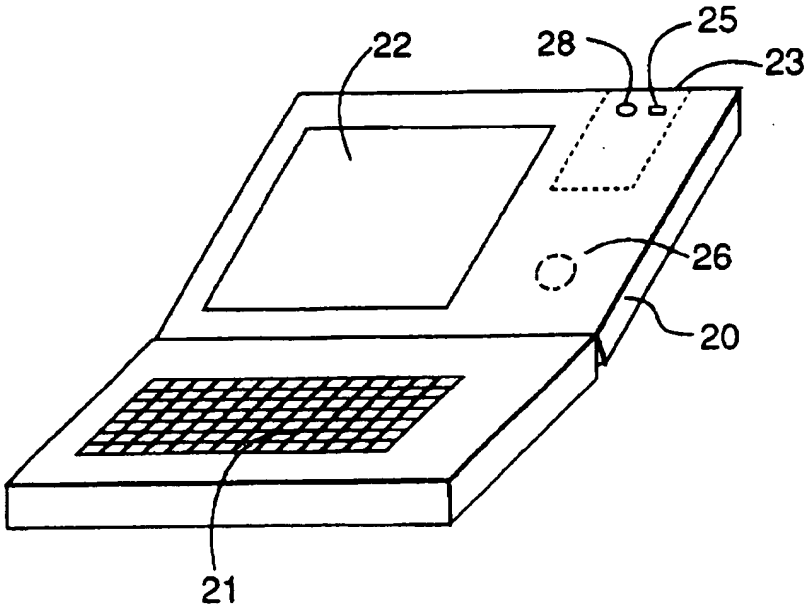


Fig.5

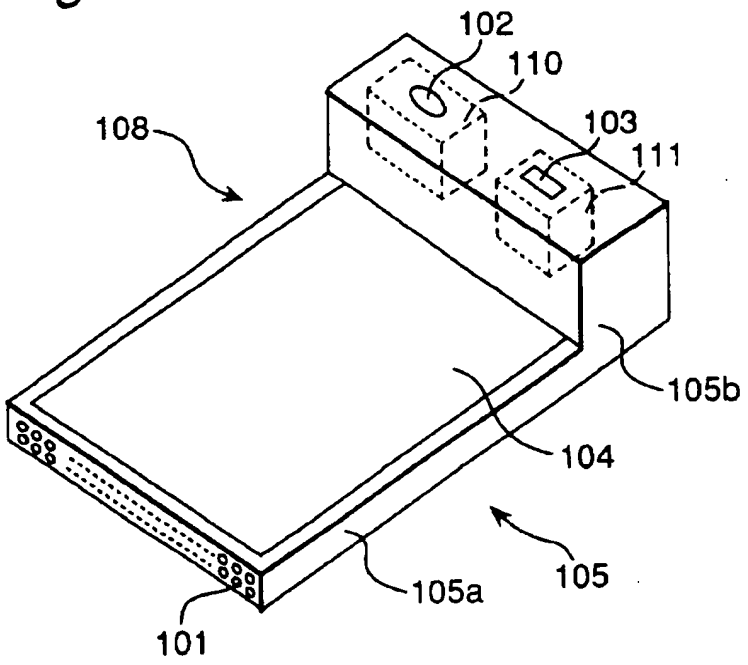


Fig.6

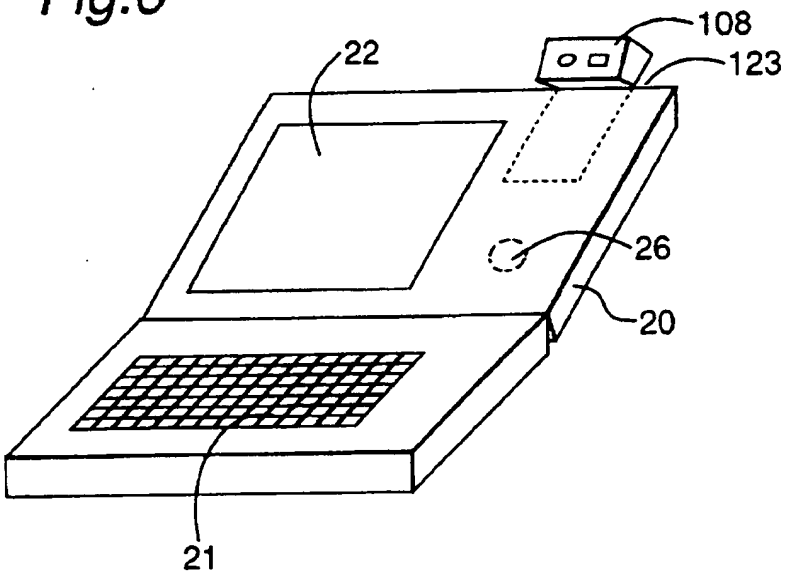


Fig.7

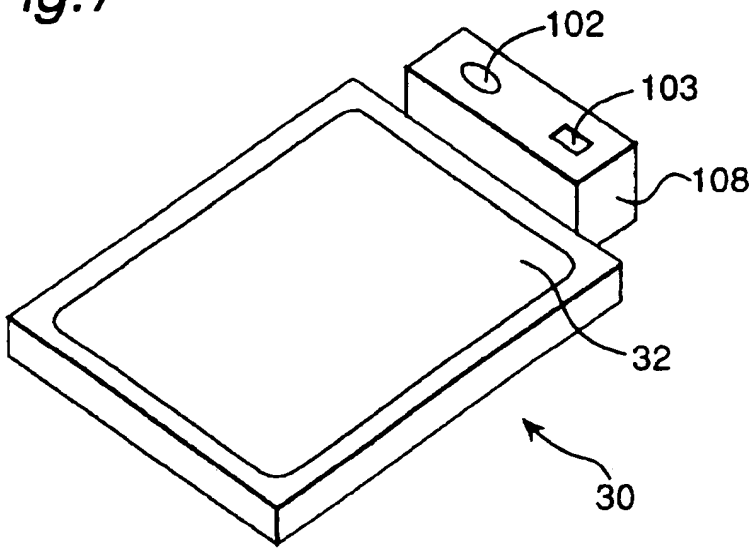

102
103
108
32
30

Fig.8

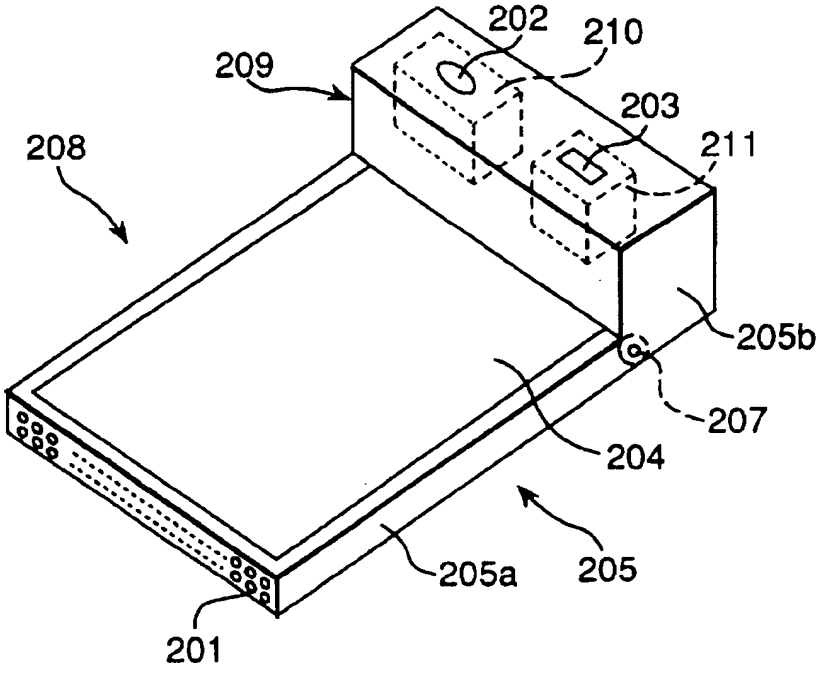

202
210
209
203
211
208
205b
207
204
205a
205
201

Fig.9

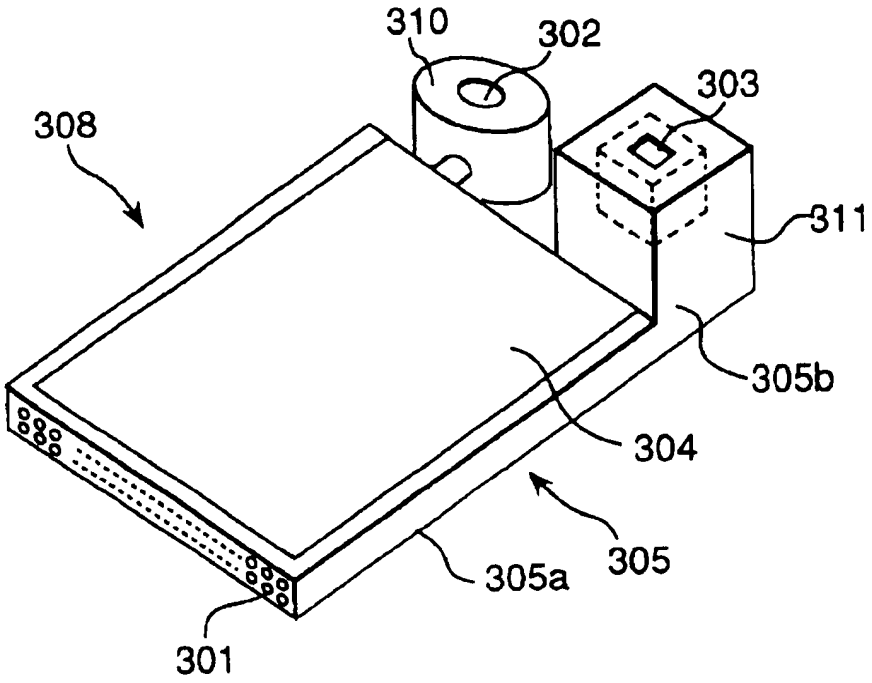


Fig.10

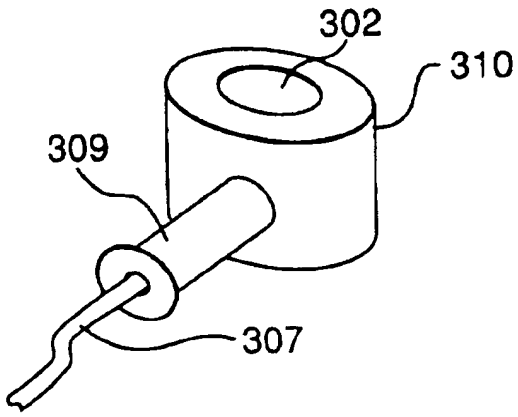


Fig. 11

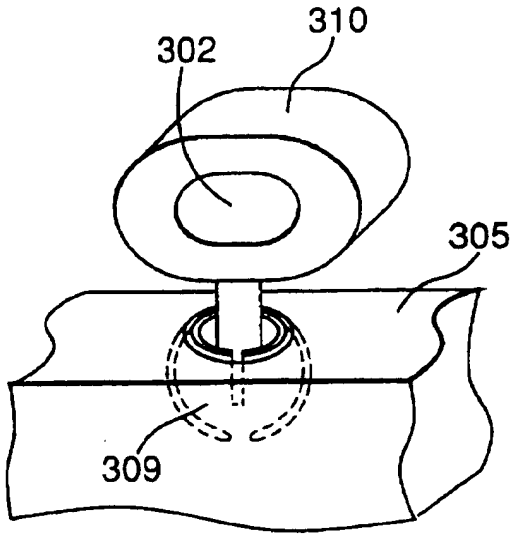


Fig. 12

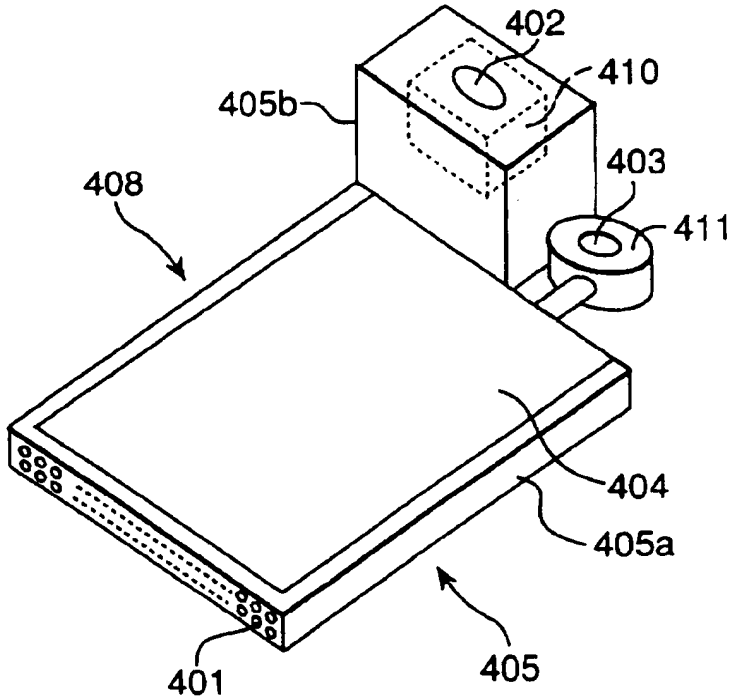


Fig.13

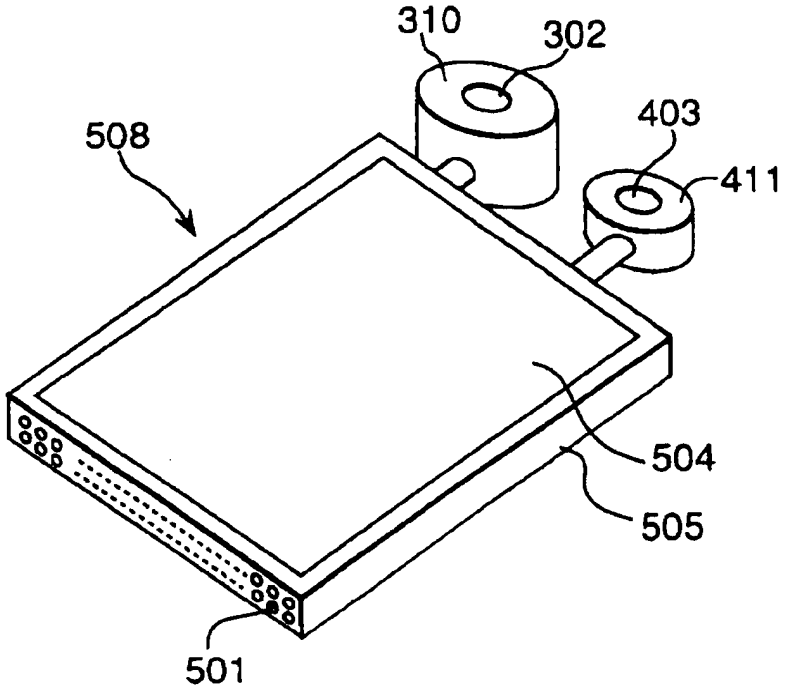

310
302
403
411
508
504
505
501

Fig.14

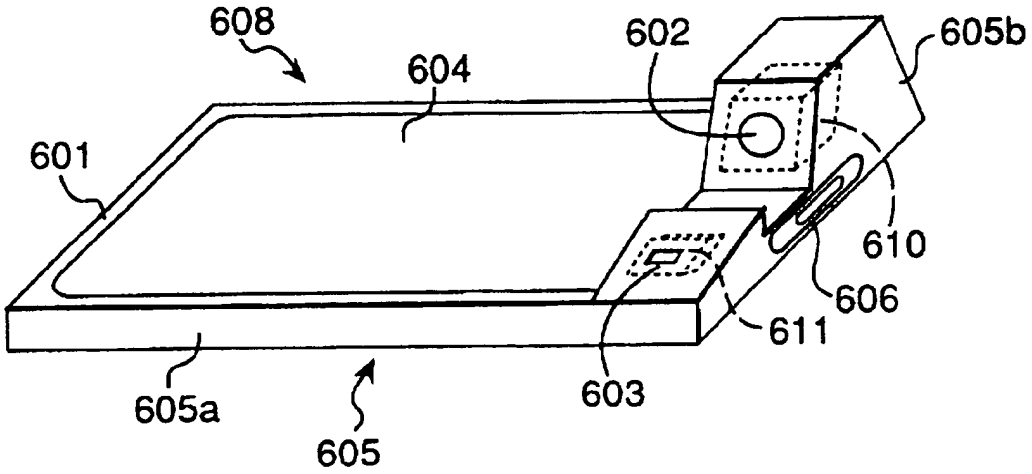
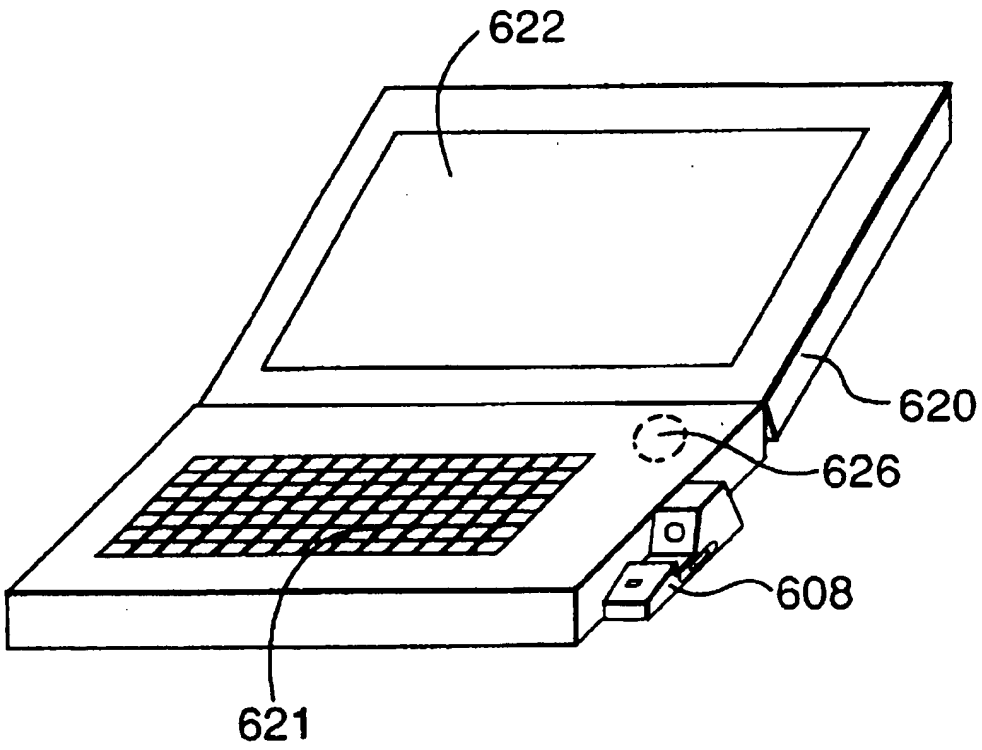

608
604
602
605b
601
610
606
611
605a
605
603

Fig. 15



IC CARD HAVING CAMERA, MICROPHONE, AND MODEM FOR USE IN INFORMATION PROCESSORS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an IC card used for information processors such as personal computers or personal digital assistants.

2. Description of the Prior Art

An IC card is a card including an integrated circuit such as a central processing unit or a memory device, and it is used as a peripheral equipment for information processing apparatuses such as a notebook-sized computer and a personal digital assistant. IC cards including a memory device such as a static random access memory or a flash memory are used as a memory medium. There are also IC cards having various functions such as a facsimile modem.

A notebook-sized computer is a portable personal computer for individual use. It can be used as a terminal for processing information, and its functions are being expanded rapidly. A terminal such as a personal digital assistant of various types for individual use will also be used widely, and it will be expected to be used for various uses such as a video conference through a communication line. Then, there are demands for IC cards and terminals serving various functions.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an IC card having various communication functions.

Another object of the present invention is to provide a terminal for processing information into which an IC card having various communication functions can be inserted.

A type of an IC card comprises an image input device converting an optical signal to an electrical signal and an acoustic input device converting an acoustic signal to an electrical signal. A transmission controller transmits an electrical signal received from the image input device or the acoustic input device through a connector to a telephone or communication line or transmits an electrical signal received from the communication line through a first connector to a terminal such as a personal computer. A frame mounts the image input device, the acoustic input device, the transmission controller, while a panel fixed to the frame encloses the image input device, the acoustic input device and the transmission controller. Further, the panel comprises a first hole for propagating an image to said image input device and a second hole for propagating a sound to said acoustic input device. This type of an IC card is used for a computer having a slot therefor and having holes corresponding to the first and second holes so as not to prevent propagation of an image and a sound when the IC card is inserted into the slot.

Another type of an IC card has a feature that a frame mounting an image input device, an acoustic input device, a transmission controller and first and second connectors comprises a main body and an extension connected thereto. The extension encloses the image input device and the acoustic input device, and it comprises a first hole for propagating an image to the image input device and a second hole for propagating a sound to the acoustic input device. This type of an IC card is used for an conventional computer without providing holes corresponding to the first and second holes. In a modified IC card, at least one of the image input device and the acoustic input device comprises a rotatable connecting member which is connected to the frame. Then, the direction of the image input device or the acoustic input device can be set in a wide range.

An advantage of the present invention is that image and acoustic signals can be dealt only by inserting an IC card into a terminal because an image input device and an acoustic input device is integrated in an IC card.

Another advantage of the present invention is that an image input device and/or an acoustic input device can be set at a desired direction by an operator.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects and features of the present invention will become clear from the following description taken in conjunction with the preferred embodiments thereof with reference the accompanying drawings, and in which:

FIG. **1** is a perspective view of an embodiment of an IC card according to the invention;

FIG. **2** is a circuit diagram of the IC card shown in FIG. **1**;

FIG. **3** is a perspective view of a notebook-sized computer into which an IC card shown in FIG. **1** can be inserted;

FIG. **4** is a perspective view of a modified example of the notebook-sized computer shown in FIG. **3**;

FIG. **5** is a perspective view of a second embodiment of an IC card according to the invention;

FIG. **6** is a perspective view of a notebook-sized computer into which an IC card shown in FIG. **5** can be inserted;

FIG. **7** is a perspective view of a personal digital assistant into which an IC card shown in FIG. **5** can be inserted;

FIG. **8** is a perspective view of a third embodiment of an IC card according to the invention;

FIG. **9** is a perspective view of a fourth embodiment of an IC card according to the invention;

FIG. **10** is a perspective view of a photoelectric converter device;

FIG. **11** is a perspective view of the photoelectric converter device connected to a frame;

FIG. **12** is a perspective view of a fifth embodiment of an IC card according to the invention;

FIG. **13** is a perspective view of a modified embodiment of the fifth embodiment of an IC card according to the invention;

FIG. **14** is a perspective view of a sixth embodiment of an IC card according to the invention; and

FIG. **15** is a perspective view of a notebook-sized personal computer having a slot for inserting the IC card shown in FIG. **14**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

When a video conference is held by using a monitor display and a speaker of a notebook-sized personal computer, personal digital assistants and the like, a video image and a sound of an operator have to be sent through a communication line, while a video image and a sound of other operators have to be displayed on the monitor display and heard with the speaker. In order to send and receive a video image and a sound, an IC card may be proposed to have functions of processing image and sound signals. For this purpose, it is possible to connect a camera unit and a microphone unit to the IC card directly or through cables. This setup has an advantage that the camera unit and the like

can be arranged at appropriate positions, but it has a disadvantage that they have to be fixed always with a hand or the like.

In the invention, an image input device and an acoustic input device are integrated with an IC card. Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the several views, FIG. **1** shows an IC card **8** of an embodiment according to the invention. In the IC card **8**, a board (not shown) mounting an electrical circuit is fixed to a frame **5**, and the frame is fixed to and protected by upper and lower panels **4** (the lower panel is not shown). The upper panel **4** has a top plane with a convex shape at the peripheral thereof. A connector **1** to be connected to a system (host) such as a personal computer is counted at an end along a longitudinal direction of the IC card **8**, in order to make it possible to communicate data with the system. Further, another or rear connector **6** (not shown) to be connected to an ISDN network (telephone line) is counted at the other end along the longitudinal direction of the IC card **8**, in order to make it possible to communicate data through the telephone line. As shown in FIG. **1**, the upper panel **4** has a hole **2** for receiving an image and a hole **3** for receiving a sound, and a photoelectric converter device **10** such as a charge-coupled device and an acousto-electric converter device **11** such as a microphone are mounted on the board fixed to the frame **5** so as to be arranged just below the holes **2** and **3**. A size of the IC card **8** is usually 85.6 mm * 54 mm.

FIG. **2** is a circuit diagram of the IC card shown in FIG. **1**. A central processing unit (CPU) **16** is connected to a ROM **17** storing a program and data and to a RAM **18** used as a data buffer. The CPU **16** communicates data with a telephone line or an external system (not shown) through a PCMCIA (Personal Computer Memory Card International Association) interface **19** and the connector **6**. On the other hand, an image (optical signal) received by the photoelectric converter device **10** through the hole **2** is converted to an electrical signal, and the signal is coded in real time by an image encoder **12** to image data to be input to a signal multiplexer/demultiplexer **14**. At the same time, a sound (acoustic signal) received by the acousto-electric converter device **11** is converted to an electrical signal, and the signal is coded in real time by an acoustic encoder **13** to sound data to be input to the signal multiplexer/demultiplexer **14**. The signal multiplexer/demultiplexer **14** allocates one slot alternately to image and acoustic input data for multiplication, for example, according to H320 standards of International telecommunication Union (ITU), and an ISDN (Integrated Services Digital Network) interface **15** sends the multiplex signals through the rear connector **6** to the ISDN network (telephone line). On the other hand, the signal multiplexer/demultiplexer **14** receives signals through the ISDN network, the connector **6** and the ISDN interface **15** and separates them to image signals and acoustic signals. The CPU **16** receives the separated signals and sends them to the system, which generates an image and a sound according to the signals. (A similar electrical circuit is mounted on boards in embodiments to be explained below, but the explanation of the circuit is omitted for concise explanation).

FIG. **3** shows a notebook-sized computer having a slot **23** for inserting the IC card **8** shown in FIGS. **1** and **2**. The computer consists of a base having a keyboard **21** and a top **20** having a display **22** and a speaker **26**. The top **20** connected to the base is moved relatively to the base. The slot **23** is provided near the display **22** so that an IC card can be inserted from above. Holes **24** and **25** for receiving an image and a sound are provided at positions in correspondence to the holes **2** and **3** of the IC card when the IC card is inserted into the slot **23**. The holes **24** and **25** are empty for propagating an image and a sound. However, a window made of a transparent material may be provided at the hole **24** for receiving an image.

FIG. **4** shows a modified example of a notebook-sized computer, wherein a lens **28** as a component of the photoelectric converter device **10** may be mounted at the hole **24**.

An IC card **8** is inserted into the personal computer shown in FIG. **3** or **4**, for example, on video conference. Signals (information) are received from the other party through the rear connector **6**, and an image included in the signals is displayed on the display **22** and a sound included in the signals is generated at the speaker **26**.

As explained above, an image input device and a sound input device are integrated in the IC card **8** shown in FIGS. **1** and **2**. Then, an image and a sound can be input only by inserting the IC card **8** into a terminal such as a personal computer shown in FIG. **3** or **4**.

FIG. **5** shows an IC card **108** of a second embodiment according to the invention. The IC card **108** includes a board (not shown) mounting an electrical circuit and fixed to a frame **105**, and the frame **105** is fixed to and protected by upper and lower two panels **104**. A connector **101** to be connected to a system (host) such as a personal computer is mounted at an end along a longitudinal direction of the IC card **108**, in order to make it possible to communicate data with the system. Further, another or rear connector **106** (not shown) to be connected to an ISDN network (telephone line) is mounted at the other end along the longitudinal direction of the IC card **108**, in order to make it possible to communicate data through the telephone line. A width of the IC card **108** is 54 mm similar to that of the IC card shown in FIG. **1**, but the length thereof is larger than 85.6 mm. The upper panel **104** is flat in contrast to the counterpart **4** of the IC card shown in FIG. **1**. Further, the frame **105** comprises a main body **105***a* and an extension **105***b* connected to an end of the main body **105***a* at the rear side. The extension **105***b* is a feature of the IC card **108**. The bottom of the extension **105***b* extends straightly from the main body **105***a* of the IC card, while the top thereof protrudes upward. A top plane of the extension **105***b* has a hole **102** for receiving an image and a hole **103** for receiving a sound, and a photoelectric converter device **110** such as a charge-coupled device and an acousto-electric converter device **111** such as a microphone are mounted on the board fixed to the frame **105** to be arranged just below the holes **102** and **103**. The direction of the top plane of the extension **105***b* is set so that an image and a sound of an operator of the computer are easy to be detected when the IC card **108** is inserted. In the example shown in FIG. **5**, the top plane of the extension **105***b* is generally parallel to the top plane of the panel **104**.

FIG. **6** shows a notebook-sized computer into which the IC card shown in FIG. **5** is inserted. The computer is similar to that shown in FIG. **3** except that no holes for receiving an image and a sound are provided in the top **20** because the IC card **108** having the extension **105***b* is inserted into a slot **123** from above. As explained above, the extension **105***b* includes the holes **102**, **103** for receiving an image and a sound, and the photoelectric converter device **110** and the acousto-electric converter device **111** both arranged just below the holes **102** and **103**. In other words, an ordinary notebooksized computer can be used for the IC card **108**.

FIG. **7** shows a personal digital assistant (PDA) into which the IC card **108** shown in FIG. **5** is inserted. The PDA comprises a display **32**, and the IC card **108** is inserted into

a slot (not shown) provided at a top end of the PDA. The IC card **108** is located just below the display **32**. Therefore, an image and a sound of an operator who operates the PDA by using a picture plane of the display can be introduced eventually through the holes **102** and **103**, and they are converted to electrical information by using the photoelectric converter device **110** and the acousto-electric device **111**.

FIG. **8** shows an IC card of a third embodiment according to the invention. The IC card comprises a main body **208** and an extension **209**, and the extension **209** is connected with a hinge **207** to the main body **208**. Thus, the extension **209** pivots against the main body **208**. This IC card **208** is similar to that shown in FIG. **5** except the hinge **207** and relevant modifications. The main body **208** includes a board (not shown) mounting an electrical circuit and fixed to a frame **205**, and the frame **205** is fixed to and protected by upper and lower panels **204** (the lower panel is not shown). A connector **201** to be connected to a system (host) such as a personal computer is mounted at an end of the frame **205** opposite to the hinge **207**. Another rear connector **206** (not shown) to be connected to an ISDN network (telephone line) is mounted in the extension **209** at an end opposite to the hinge **207**. The bottom of the extension **209** extends continuously from the main body of the IC card, while the top thereof protrudes upward. A top plane of the extension **209** has a hole **202** for receiving an image and a hole **203** for receiving a sound, while a photoelectric converter device **210** such as a charge-coupled device and an acousto-electric converter device **211** such as a microphone are arranged just below the holes **202** and **203**.

In the IC card **208**, the extension **209** is connected with a hinge **207** to the main body **208**. Therefore, the direction of the extension **209** can be changed back and forth along the longitudinal direction of the IC card. Then, if the IC card is inserted into the personal computer as shown in FIG. **3**, an image other than the operator can be transmitted by changing the direction of the extension **209** back and forth. Further, if the IC card is inserted into the personal digital assistant **30** as shown in FIG. **7**, an image other than the operator can also be transmitted by changing the direction of the holes **102** and **103**.

FIG. **9** shows an IC card **308** of a fourth embodiment according to the invention wherein the direction of a photoelectric converter device **310** can be changed freely. The IC card **308** includes a board (not shown) mounting an electrical circuit and fixed to a frame **305**, and the frame **305** is fixed to and protected by upper and lower panels **304** (the lower panel is not shown). A connector **301** to be connected to a system (host) such as a personal computer is mounted at an end along a longitudinal direction of the IC card **308**. Further, another connector **306** (not shown) to be connected to an ISDN network (telephone line) is mounted at the other end along the longitudinal direction of the IC card **308**. The frame **305** comprises a main body **305***a* and an extension **305***b* connected to the main body **305***a* at an end thereof along the longitudinal direction. The extension **305***b* exists only at the right side. The bottom of the extension **305***b* extends straightly from the main body of the IC card, while the top thereof protrudes upward. A top plane of the extension **305***b* has a hole **303** for receiving a sound, and an acousto-electric converter device **311** such as a microphone is mounted so as to be arranged just below the hole **303**. It is a feature of this embodiment that the photoelectric converter device **310** such as a charge-coupled device is connected to the main body **305***a* of the frame **305** with a spherical joint **309** (refer to FIG. **10**) and it has a hole **302** for receiving an image at a front side thereof.

FIG. **10** shows the photoelectric converter device **310** having the spherical joint **309** having a spherical part at an end thereof. The device **310** is connected with the spherical joint **309** to the frame **305** of the IC card mechanically and with a cable **307** to the IC card electrically. FIG. **11** shows a situation of the photoelectric converter device **310** connected to the frame **305**. The direction of the hole **302** of the photoelectric converter device **305***b* can be changed by rotating the device **310** with the spherical joint **309**.

FIG. **12** shows an IC card **408** of a fifth embodiment according to the invention, wherein the direction of an acousto-electric converter device **411** can be changed freely. A structure of the acousto-electric converter device **410** for connection to a frame **405** of the IC card **408** is similar to that of the photoelectric converter device **410** shown in FIGS. **9–11**. The IC card **408** includes a board (not shown) mounting an electrical circuit and fixed to the frame **405**, and the frame **405** is fixed to and protected by upper and lower panels **404** (the lower panel is not shown). A connector **401** to be connected to a system (host) such as a personal computer is mounted at an end along a longitudinal direction of the IC card **408**. Further, another connector **406** (not shown) to be connected to an ISDN network (telephone line) is mounted at the other end along the longitudinal direction of the IC card **408**. The frame **405** comprises a main body **405***a* and an extension **405***b* connected to the main body **405***a* at an end thereof along the longitudinal direction. The extension **405***b* exists only at the left side. The bottom of the extension **405***b* extends straightly from the main body of the IC card, while the top thereof protrudes upward. A top plane of the extension **405***b* has a hole **402** for receiving an image, and a photoelectric converter device **410** such as a charge-coupled device is arranged just below the hole **402**. It is a feature of this embodiment that the acousto-electric converter device **411** such as a microphone is connected to the main body **405***a* with a spherical joint (not shown), and a hole **403** for receiving a sound is provided at a front side thereof.

FIG. **13** shows an IC card **508** of a modified embodiment of the fifth embodiment, wherein the directions of a photoelectric converter **310** and an acousto-electric converter device **411** can be changed freely with spherical joints (not shown). Structures of the photoelectric converter device **310** and the acousto-electric converter device **411** for connection to a frame **405** of the IC card **508** are the same as the counterparts of the photoelectric converter device **310** shown in FIGS. **9–11** and the acousto-electric converter device **411** shown in FIG. **12**. The IC card **508** includes a board (not shown) mounting an electrical circuit and fixed to the frame **505**, and the frame **505** is fixed to and protected by upper and lower panels **504** (the lower panel is not shown). A connector **501** to be connected to a system (host) such as a personal computer is mounted at an end along a longitudinal direction of the IC card **508**. Further, another connector **506** (not shown) to be connected to an ISDN network (telephone line) is mounted at the other end along the longitudinal direction of the IC card **508**.

As explained above, in the IC cards shown in FIGS. **9–14**, the direction of the devices for receiving a sound and/or an image can be changed as desired by an operator.

FIG. **14** shows an IC card **608** of a sixth embodiment according to the invention. The IC card **608** arranges a photoelectric converter device **610** and an acousto-electric converter device **611** at a shorter side thereof similarly to that shown in FIG. **5**, but with different directions thereof. The IC card **608** includes a board (not shown) mounting an electrical circuit and fixed to a frame **605**, and the frame **605**

is fixed and protected by upper and lower panels **604** (the lower panel is not shown). A connector **601** (not shown) to be connected to a system (host) such as a personal computer is mounted at an end along a longitudinal direction of the IC card **608**. Further, another connector **606** to be connected to an ISDN network (telephone line) is mounted at the other end along the longitudinal direction of the IC card **608**. Further, the frame **605** comprises a main body **605***a* and an extension **605***b* connected to the main body **605***a* at a shorter side of the IC card. The bottom of the extension **605***b* extends straightly from the main body **605***a* of the IC card, while the top thereof protrudes upward. A top plane of the extension **605***b* has a hole **602** for receiving an image and a hole **603** for receiving a sound, and the photoelectric converter device **610** such as a charge-coupled device and the acousto-electric converter device **611** such as a microphone are mounted on the board fixed to the frame **605** to be arranged just below the holes **602** and **603**. The direction of planes having the holes **602** and **603** are slant with respect to the top panel **604** so that the holes **602** and **603** for receiving an image and a sound of an operator can face the operator when the IC card **608** is inserted.

FIG. **15** shows a notebook-sized personal computer. The computer consists of a base having a keyboard **621** and a speaker **626**, and a top **620** having a display **622**. The top **620** connected to the base is movable relatively to the base. The computer has a slot (not shown) for inserting an IC card **608** shown in FIG. **14**. The slot is provided beside the display **622**, and it is hidden in FIG. **15** by the IC card **608** inserted into the slot. By adjusting an angle of the IC card **608** or the holes **602** and **603** for receiving an image and a sound, an image and a sound of an operator can be transmitted surely.

Although the present invention has been fully described in connection with the preferred embodiments thereof with reference to the accompanying drawings, it is to be noted that various changes and modifications are apparent to those skilled in the art. Such changes and modifications are to be understood as included within the scope of the present invention as defined by the appended claims unless they depart therefrom.

What is claimed is:

1. An IC card comprising:

a first connector connectable to a terminal for processing information;

a second connector connectable to a communication line;

an image input device converting an optical signal to an electrical signal;

an acoustic input device converting an acoustic signal to an electrical signal;

a transmission controller transmitting an electrical signal received from said image input device or said acoustic input device through said second connector to the communication line and transmitting an electrical signal received from the communication line through said first connector to the terminal;

a frame mounting said image input device, said acoustic input device, said transmission controller and said first and second connectors;

a panel connected to said frame, said panel enclosing said first connector, said second connector, said image input device, said acoustic input device and said transmission controller;

wherein said panel comprises a first hole for propagating an image to said image input device and a second hole for propagating a sound to said acoustic input device.

2. The IC card according to claim **1**, wherein said transmission controller comprises a signal multiplexer which generates multiplex signals of the electrical signals received from said image input device and from said acoustic input device and transmits the multiplex signals through said second connector to the communication line.

3. The IC card according to claim **1**, wherein said transmission controller comprises a signal demultiplexer which separates image signals and acoustic signals from multiplex signals received through said second connector and sends the image and acoustic signals through said first connector to the terminal.

4. An IC card comprising:

a first connector connectable to a terminal for processing information;

a second connector connectable to a communication line;

an image input device converting an optical signal to an electrical signal;

an acoustic input device converting an acoustic signal to an electrical signal;

a transmission controller transmitting an electrical signal received from said image input device or said acoustic input device through said second connector to the communication line and transmitting an electrical signal received from the communication line through said first connector to the terminal;

a frame mounting said image input device, said acoustic input device, said transmission controller and said first and second connectors, said frame comprising a main body and an extension connected thereto, said extension enclosing said image input device and said acoustic input device and mounting said second connector at an end thereof, said extension comprising a first hole for propagating an image to said image input device and a second hole for propagating a sound to said acoustic input device; and

a panel connected to said frame, said panel enclosing said transmission controller.

5. The IC card according to claim **4**, wherein said extension has a surface at which said first and second holes are provided, and the surface is parallel to an upper surface of said panel along a direction perpendicular to the longitudinal direction of said frame.

6. The IC card according to claim **4**, wherein said extension has a first surface at which said first hole is provided and a second surface at which said second hole is provided, and the surfaces are slant with respect to an upper surface of said panel along a direction perpendicular to the longitudinal direction of said frame.

7. The IC card according to claim **4**, wherein said frame comprises a main body and said extension, said frame further comprising a hinge connecting said main body to said extension.

8. The IC card according to claim **4**, wherein said transmission controller comprises a signal multiplexer which generates multiplex signals of the electrical signals received from said image input device and from said acoustic input device and transmits the multiplex signals through said second connector to the communication line.

9. The IC card according to claim **4**, wherein said transmission controller comprises a signal demultiplexer which separates image signals and acoustic signals from multiplex signals received through said second connector and sends the image and acoustic signals through said first connector to the terminal.

10. An IC card comprising:

a first connector connectable to a terminal for processing information;

a second connector connectable to a communication line;

an image input device converting an optical signal to an electrical signal, said image input device comprising a first hole for propagating an image;

an acoustic input device converting an acoustic signal to an electrical signal, said acoustic input device comprising a second hole for propagating a sound;

a transmission controller transmitting an electrical signal received from said image input device or said acoustic input device through said second connector to the communication line and transmitting an electrical signal received from the communication line through said first connector to the terminal;

a frame mounting said image input device, said acoustic input device, said transmission controller and said first and second connectors; and

a panel connected to said frame, said panel enclosing said transmission controller and said first and second connectors;

wherein one of said image input device and said acoustic input device comprising a rotatable connecting member which is connected to said frame.

11. The IC card according to claim 10, wherein said connecting member comprises a spherical joint.

12. The IC card according to claim 10, wherein said image input device comprises said connecting member.

13. The IC card according to claim 10, wherein said acoustic input device comprises said connecting member.

14. The IC card according to claim 12, wherein said acoustic input device comprises said connecting member.

15. The IC card according to claim 10, wherein said transmission controller comprises a signal multiplexer which generates multiplex signals of the electrical signals received from said image input device and from said acoustic input device and transmits the multiplex signals through said second connector to the communication line.

16. The IC card according to claim 10, wherein said transmission controller comprises a signal demultiplexer which separates image signals and acoustic signals from multiplex signals received through said second connector and sends the image and acoustic signals through said first connector to the terminal.

17. A terminal for processing information comprising a casing and an electrical circuit enclosed by the casing, the casing comprising:

a slot for inserting an IC card enclosing an image input device converting an optical signal to an electrical signal, said image input device comprising a first hole for propagating an image, an acoustic input device converting an acoustic signal to an electrical signal, said acoustic input device comprising a second hole for propagating a sound, the IC card transmitting the electrical signals received from the image input device and said acoustic input device to the terminal; and

third and fourth holes provided at positions in correspondence to the first and second holes when the IC card is inserted into said slot.

18. The terminal according to claim 17, wherein said image input device comprises a lens, and the lens is mounted to said third hole.

* * * * *

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United States Patent [19]

Köppä

[11] Patent Number: 6,088,746

[45] Date of Patent: Jul. 11, 2000

[54] **MODE SELECTION LINE FOR SELECTING ONE OF A PLURALITY OF OPERATION MODES SAID SELECTION LINE CAN ALSO BE USED FOR ORIGINAL PURPOSE AFTER MODE SELECTION**

[75] Inventor: **Vesa Köppä** , Tampere, Finland

[73] Assignee: **Nokia Mobile Phones Ltd.**, Espoo, Finland

[21] Appl. No.: **08/991,136**

[22] Filed: **Dec. 16, 1997**

[30] **Foreign Application Priority Data**

Dec. 19, 1996 [FI] Finland 965107

[51] **Int. Cl.**[7] **G06F 13/14**

[52] **U.S. Cl.** **710/63**; 710/105; 348/222; 348/232

[58] **Field of Search** 710/1, 62, 63, 710/105; 348/222, 232

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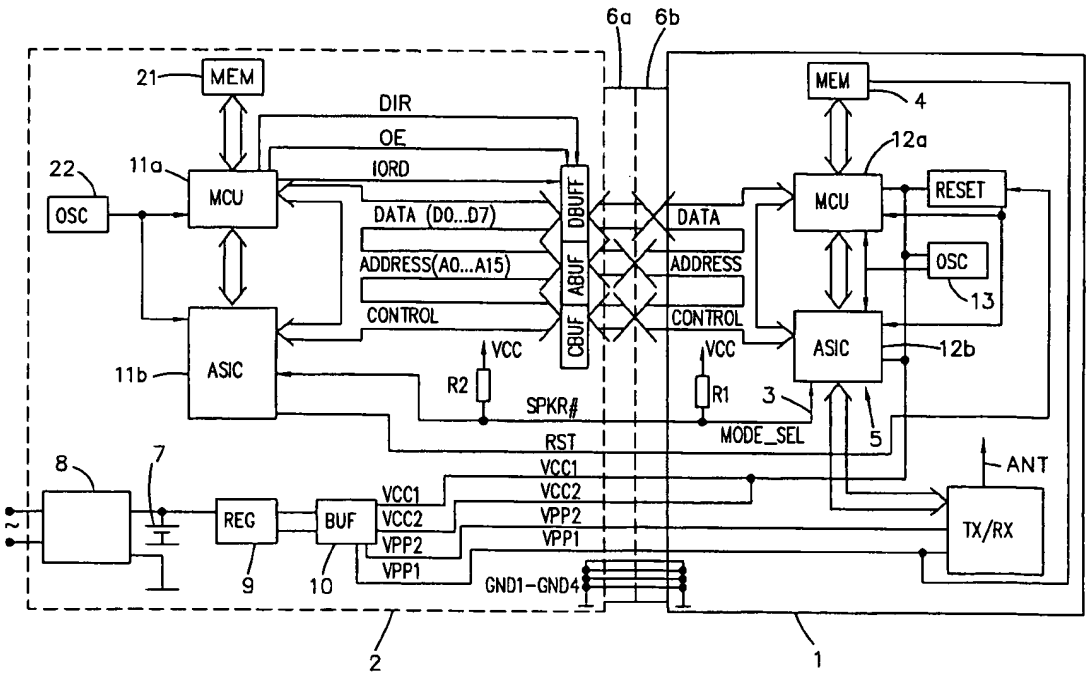
Primary Examiner—Thomas C. Lee
Assistant Examiner—Abdelmoniem Elamin
Attorney, Agent, or Firm—Perman & Green, LLP

[57] **ABSTRACT**

An expansion card (**1**) of an electronic device (**2**) comprises in accordance with the invention at least one expansion-card connector (*6b*) for connecting the expansion card (**1**) to an expansion-card connector (*6a*) of an electronic device. The expansion card (**1**) has at least one standard normal operation mode and at least one special operation mode which differs at least partially from said standard. The operation mode is arranged to be selected by at least one mode-selection line (**3**) which is connected to a contact pin of the expansion-card connector (*6b*), which contact pin has a respective contact pin (SPKR#, IREQ#, IOIS16#, WAIT#, STSCHG#) for the expansion-card connector (*6a*) of the electronic device (**2**), said respective contact pin being defined in said standard as an input line of the electronic device, which can be used, if necessary, also for the original purpose.

13 Claims, 6 Drawing Sheets



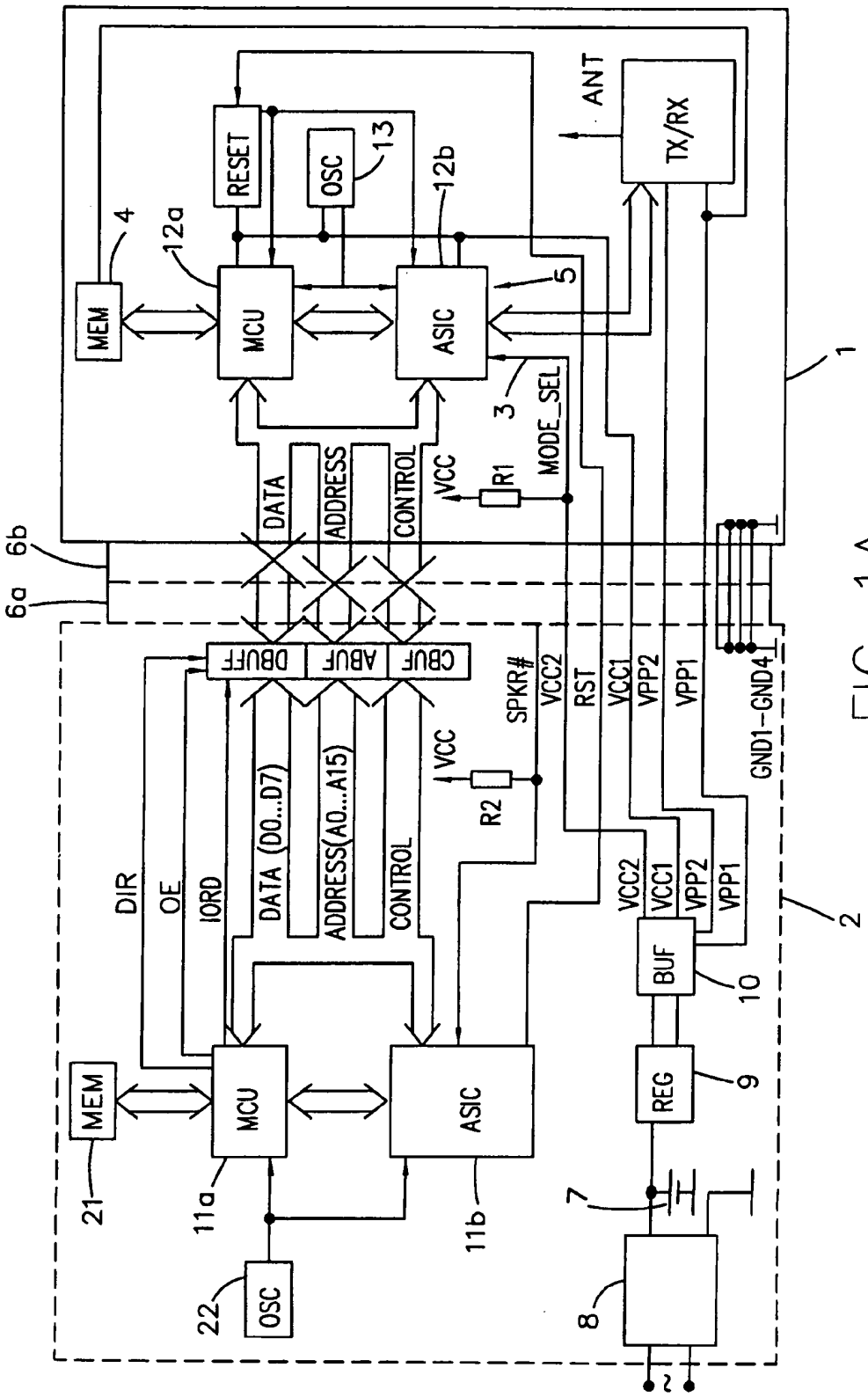


FIG. 1A
(PRIOR ART)

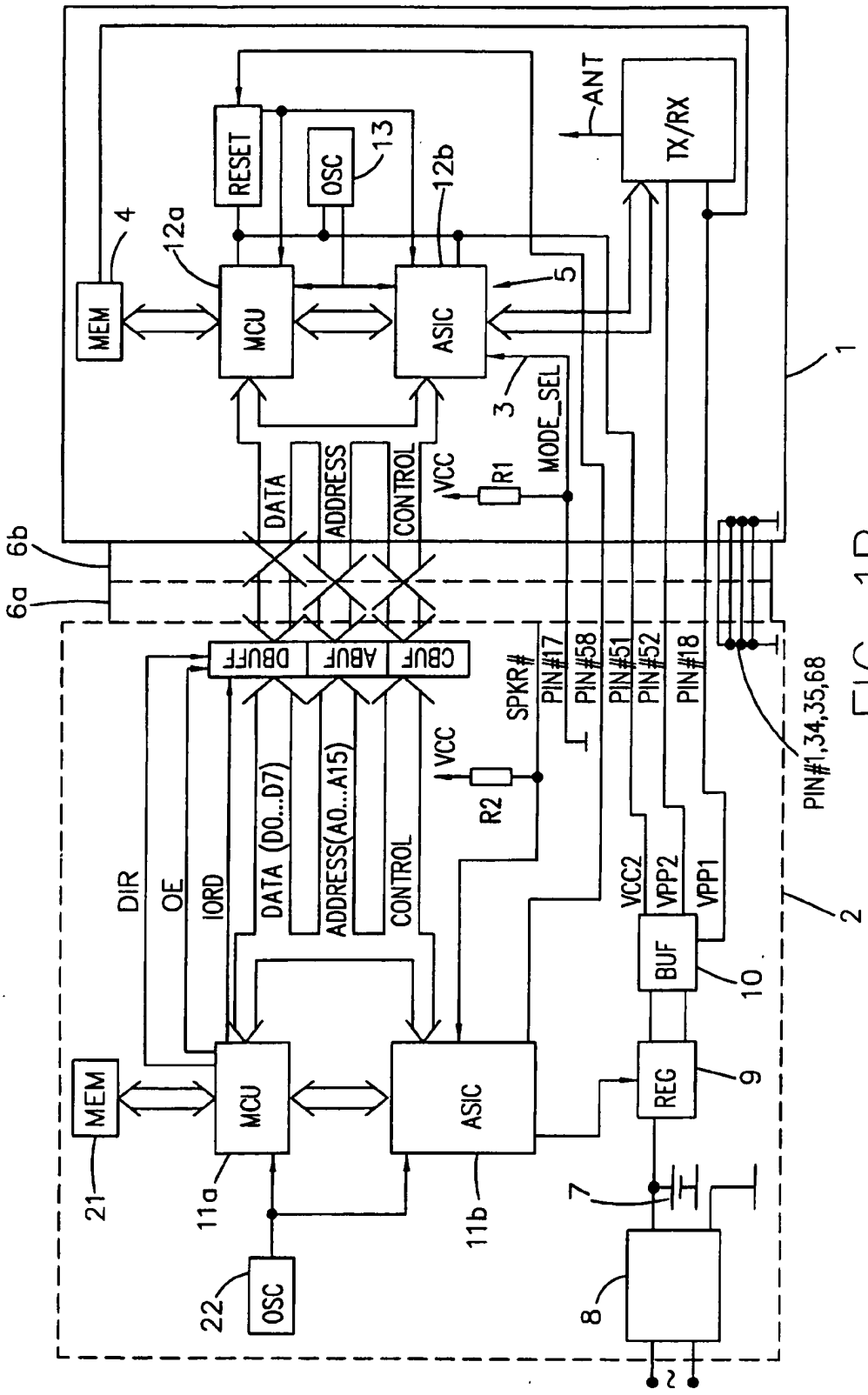


FIG. 1B
(PRIOR ART)

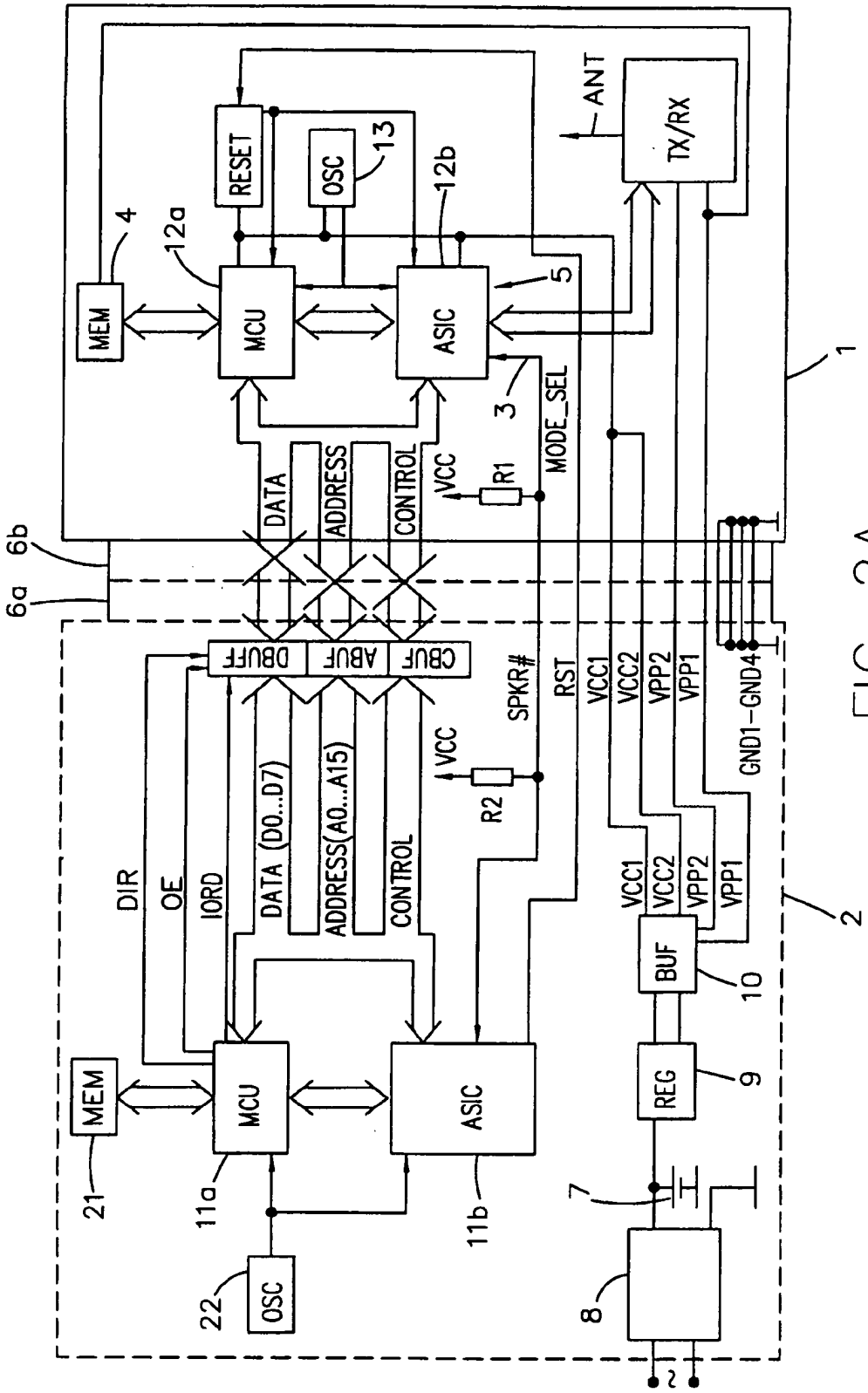

RESET
OSC
13
12b
ANT
TX/RX
4
12a
MEM
MCU
ASIC
5
1
3
MODE_SEL
VCC
R1
DATA
ADDRESS
CONTROL
6b
6a
DBUF
ABUF
CBUF
SPKR#
RST
VCC1
VCC2
VPP2
VPP1
GND1-GND4
VCC
R2
DIR
OE
IORD
DATA (D0...D7)
ADDRESS(A0...A15)
CONTROL
2
BUF
10
REG
9
MEM
MCU
ASIC
21
11a
11b
7
22
OSC
8

FIG. 2A

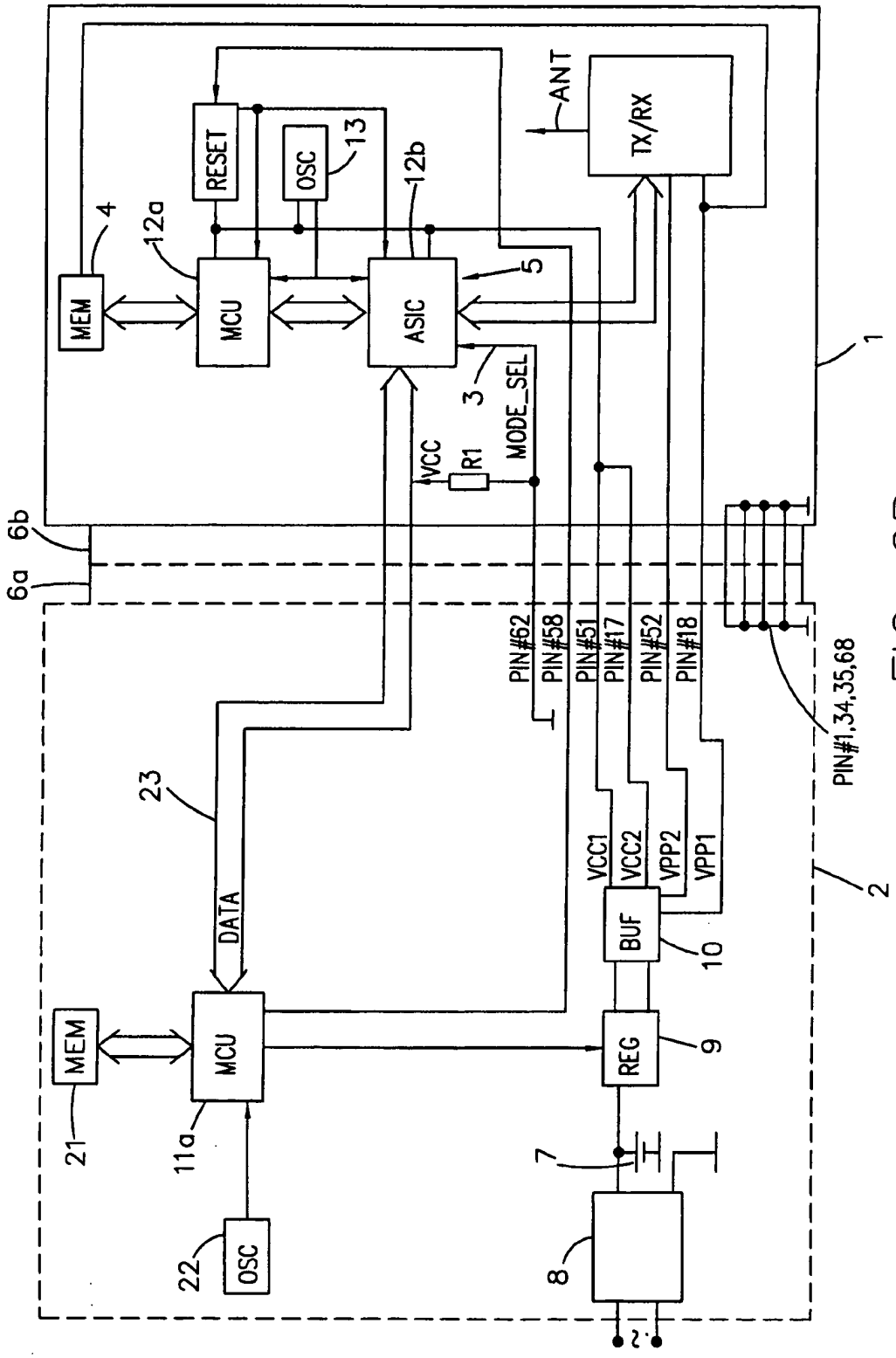

ANT
TX/RX
RESET
OSC
13
12b
4
12a
MEM
MCU
ASIC
5
3
MODE_SEL
VCC
R1
1
6b
6a
PIN#62
PIN#58
PIN#51
PIN#17
PIN#52
PIN#18
PIN#1,34,35,68
23
DATA
VCC1
VCC2
VPP2
VPP1
BUF
10
2
MEM
MCU
REG
9
21
11a
7
22
OSC
8

FIG. 2B

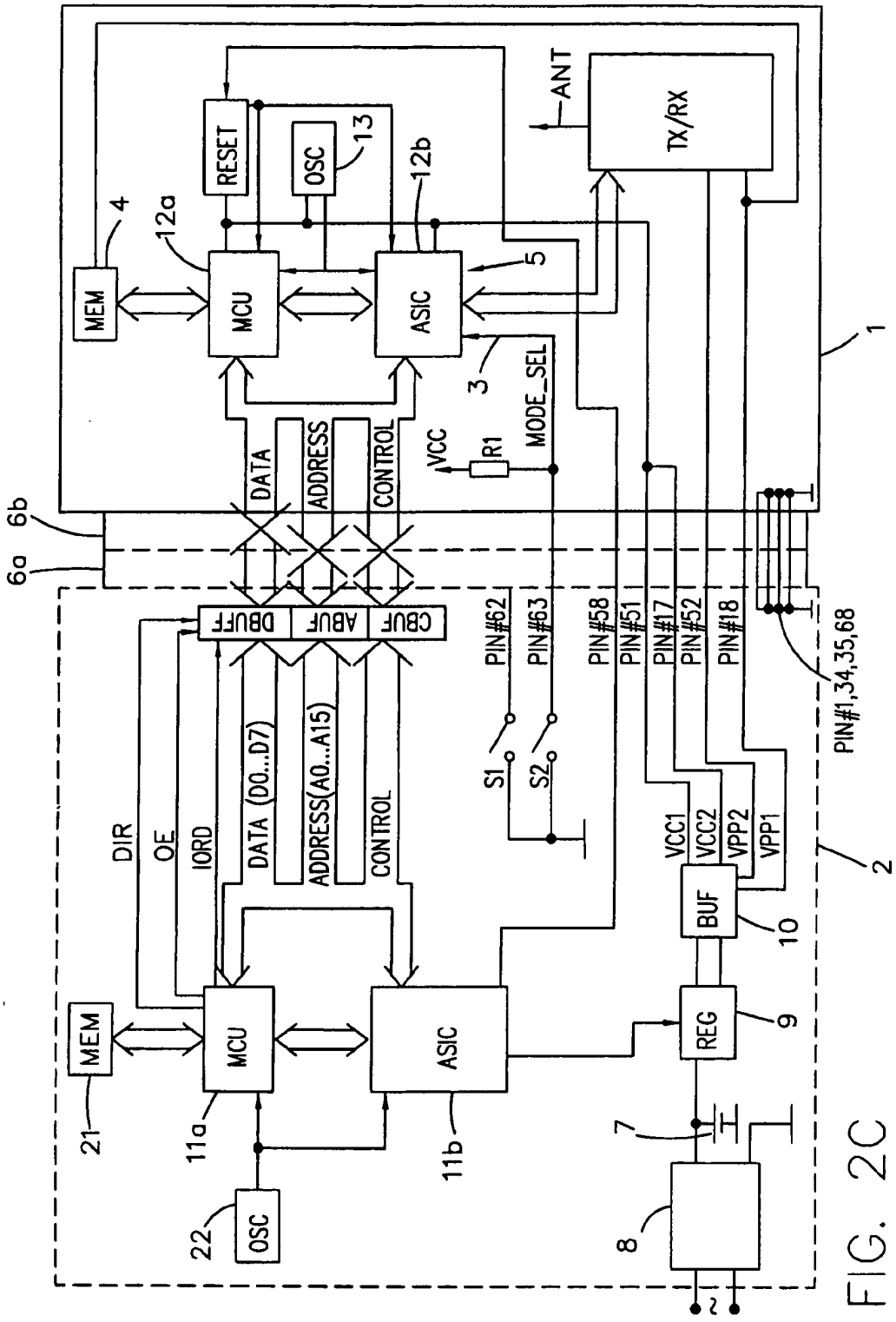
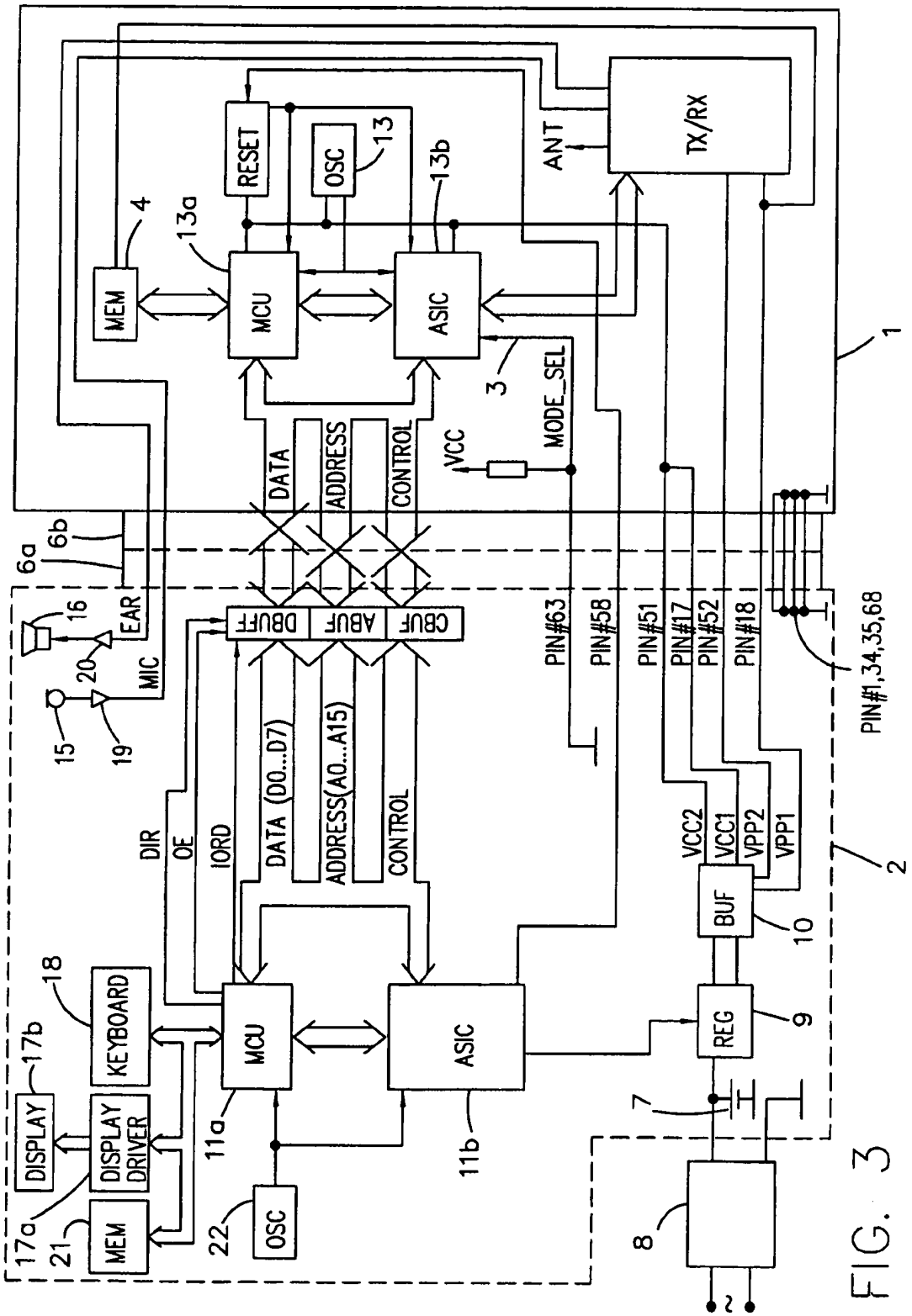

ANT
TX/RX
RESET
OSC
13
12b
12a
4
MEM
MCU
ASIC
5
3
MODE_SEL
VCC
R1
DATA
ADDRESS
CONTROL
1
6b
6a
DBUF
ABUF
CBUF
PIN#62
PIN#63
PIN#58
PIN#51
PIN#17
PIN#52
PIN#18
PIN#1,34,35,68
S1
S2
DIR
OE
IORD
DATA (D0...D7)
ADDRESS(A0...A15)
CONTROL
VCC1
VCC2
VPP2
VPP1
2
BUF
10
REG
9
7
8
21
11a
11b
22
OSC

FIG. 2C


TX/RX
ANT
RESET
OSC
13
13b
13a
4
MEM
MCU
ASIC
3
MODE_SEL
VCC
DATA
ADDRESS
CONTROL
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6a
6b
16
EAR
20
MIC
15
19
DBUFF
ABUF
CBUF
PIN#63
PIN#58
PIN#51
PIN#17
PIN#52
PIN#18
PIN#1,34,35,68
DIR
OE
IORD
DATA (D0...D7)
ADDRESS(A0...A15)
CONTROL
VCC2
VCC1
VPP2
VPP1
2
BUF
10
18
KEYBOARD
17b
DISPLAY
DISPLAY DRIVER
17a
21
MEM
MCU
ASIC
11a
11b
22
OSC
REG
9
7
8

FIG. 3

MODE SELECTION LINE FOR SELECTING ONE OF A PLURALITY OF OPERATION MODES SAID SELECTION LINE CAN ALSO BE USED FOR ORIGINAL PURPOSE AFTER MODE SELECTION

The present invention relates to an expansion card according to the preamble of claim **1**, expansion-card interface according to the preamble of claim **4**, and electronic device according to the preamble of claim **7**.

A PCMCIA interface (Personal Computer Memory Card International Association) is one known interface which is used in connection with electronic devices to connect expansion cards, such as memory cards (for example flash memory cards), modems and various kinds of input/output cards (I/O), to an electronic device. Such electronic devices and PCMCIA cards include connectors according to PCMCIA standard, for example such that the connector of electronic device is a so-called male connector (connector with contact pins), and the connector of the interface card is a so-called female connector (connector with jointing sleeves). Thus, an electrical contact is formed between each contact pin and the corresponding jointing sleeve when the interface card is connected to the connector of the electronic device. The PCMCIA standard defines the normal function of each contact pin and each jointing sleeve respectively. Thus, for example in an application where PCMCIA interface is realized in a computer, each data line of the data bus of the computer is connected to one of the contact pins of the PCMCIA interface. Additionally, at least a part of the address and control lines are connected to the connector.

The PCMCIA cards have a size of a credit card (85.6 mm×54 mm), but the thickness of the cards can be 3.3 mm (type I), 5.0 mm (type II) or 10.5 mm (type III). The PCMCIA cards are connected electrically to the electronic device as 8/16 bit I/O interface or memory. According to the PCMCIA standard, the PCMCIA card will have a memory area which can be read by the electronic device. This memory area includes information for the identification of the card. This information is called card information structure (CIS).

In particular, in connection with portable data processors (PC), mobile station embodiments have been designed, in which at least a transmitter/receiver unit TX/RX of the mobile station is provided in the PCMCIA standard card form. FIGS. **1***a* and **1***b* show a reduced block diagram of the transmitter/receiver unit of one mobile station, which is illustrated in block **1** positioned in a PCMCIA card. The unit controlling the operation of the card is advantageously a microcontroller **12***a* (MCU) having e.g. a processor, memory (RAM, ROM), and input/output lines for connecting the microprocessor to other electronics of the card. In addition, external memory **4** can be connected to the microcontroller **12***a*.

A transmitter TX comprises e.g. a modulator for modulating the signal to be transmitted, filters in particular for attenuating spurious emissions, a mixer in which the modulated signal is mixed to a local oscillator frequency for creating a radio frequency signal, and a power amplifier for amplifying the signal to be sent. The amplified signal is directed to an antenna ANT, which is connected to the card e.g. by means of a cable. A receiver RX comprises e.g. filters for filtering the received signals, a mixer for converting the radio frequency signal to be received to an intermediate frequency or, in a direct-change type receiver, to a baseband, and a detector for demodulating the received signal. Furthermore, the card has interface circuits, such as a control

circuit **12***b* (ASIC), for transferring of signals between the PC and the transmitter/receiver. The transmitter/receiver unit has no power supply of its own, but the power supply is provided from the PC via the PCMCIA connection.

The watch-dog circuit RESET of the expansion card keeps the microcontroller **12***a* of the card at the initial phase, if the operating voltage of the card is, for some reason, insufficient. Thus, malfunctions of the microcontroller are eliminated e.g. during the coupling of the voltages.

Often these kinds of expansion cards, such as PCMCIA cards have, in addition to the standard operation mode one or several operation modes which differs, at least partially, from the definitions of the standard. The standard operation mode is in this description designated as a special operation mode and those operation modes that differ from the standard are designated as a special operation mode. These special operation modes can be used e.g. in connection with the manufacture of the card when testing the operation and when clarifying and repairing operational malfunctions that possibly take place during the operation. A further possible use of the special operation mode is a situation in which the electronic device provided with a standard card interface cannot be used. The expansion card is implemented in a manner that at least a part of the properties of the card operate by positioning it to a special operation mode, which extends the possibilities and objects to use the expansion card. However, the problem is how to set the operation mode of the card to the desired mode.

The card interfaces of electronic devices are implemented according to the definitions of the standard used at the time. However, no other operation modes than the PCMCIA operation mode are defined in the PCMCIA standard, wherein neither the selection of mode is implemented in the standard. The PCMCIA interface comprises no supplementary contact pins or contact pins regarded for general use which could be used for implementation of such mode selection.

FIGS. **1***a*, **1***b* show one prior art solution for selecting the operation mode of the interface card. The interface card **1** comprises a mode selection means **5**, which is advantageously implemented in a control logic circuit (SMART ASIC) or microcontroller **12***a*. To the mode selection means a mode-selection line **3** (MODE_SEL) is directed, this line **3** being connected to the contact pin of the expansion card, which pin is, in this connection, a second supply pin V_{cc2} of operating voltage. Thus, operating voltage is supplied to the expansion card only from a first supply pin V_{cc1} of operating voltage. The mode selection means examines the mode of the mode-selection line when the expansion card is turned on. The mode-selection line is usually directed to the control logic circuit of the expansion card, at some interface line (I/O, Input-Output) or directly to the interface line for the microcontroller **12***a* of the expansion card, wherein the initial measures for the operation mode of the card are carried out in the application software of the microcontroller **12***a* of the expansion card on the basis of the mode of the line. In case the line is at the first mode (e.g. logic 1 state), as shown in FIG. **1***a*, where the expansion card is connected to a standard expansion-card interface, the expansion card is directed to operate at the normal operation mode. In a corresponding manner, in case the line is at the second mode (e.g. logic 0 state), as shown in FIG. **1***b*, where the expansion card is connected to a non-standard expansion-card interface, e.g. for testing, the expansion card is moved to operate at special operation mode. A resistance R1 operates mainly as a means that stabilizes the mode of the mode-selection line for preventing erroneous interpre-

tations. A factor restricting the operation of the method in accordance with FIGS. 1*a* and 1*b* is e.g. the fact that operating voltage can be supplied to the expansion card only via one supply line of the operating voltage, which restricts the limit for the maximum allowable power consumption of the interface card to 0.5 A in practical embodiments. This restriction arises mainly from the fact that the maximum allowable value for the current that is led via the contact pins is said 0.5 A. Many embodiments, such as the above-described mobile-station embodiment, the power consumption can be greater than 0.5 A, wherein this mode selection arrangement is not applicable.

A prior patent application FI-935272 of the applicant discloses an expanded PCMCIA interface wherein one operating voltage pin and at the most three ground-potential pins are connected to a second voltage in relation to a standard voltage. One of these pins would thus be selected for mode selection. Furthermore, a supply pin of operating voltage, or a supply pin of ground potential, intended for use in mode selection can no longer be used for the original purpose of power supply. As a result of this, the power to be supplied to the expansion card is reduced, because there are fewer connection pins available for supplying the same power. The solution described in said publication is applicable mainly for expansion cards with a reasonable power consumption. Moreover, in different electronic devices, there is often already the second power supply line or a ground potential line defined in a different way, wherein such an expansion card ends up in an incorrect operation mode by accident when the expansion card is connected with the electronic device. In a connection according to the present application, however, there is no such risk, because the mode selection line used is always a contact pin which is an input line to the electronic device. Such lines have usually a relatively high input impendance, and the expansion card is always set into the operation mode intended.

An object of the present invention is to decrease the above-described drawbacks and to provide an expansion-card interface having at least two operation modes, one of which is selected for each turn on, and an expansion-card interface whereby the operation mode of the expansion card can be selected and still a maximal current supply is attained for the expansion card. The invention is based on the idea that the mode-selection line used is a contact pin which, with regard to the electronic device that controls the expansion card, is the input line and which can be used also for the original purpose, if necessary. When selecting the operation mode, it is also possible to use more than one mode-selection line, in particular for cards having more than one special operation mode. The expansion card in accordance with the invention is characterized by what is described in the characterizing portion of the accompanying claim 1. The expansion-card interface in accordance with the invention is characterized by what is described in the characterizing portion of the accompanying claim 4. Additionally, the electronic device in accordance with the invention in accordance with the invention is characterized by what is described in the characterizing portion of the accompanying claim 7.

The present invention provides significant advantages over prior art solutions. Selection of the operation mode in accordance with the invention does not limit the current intensity which can be supplied to the expansion card, because operating voltage lines and ground-potential lines are used as mode-selection lines. Further, the expansion card connected to an electronic device provided with a standard interface operates according to said standard. Yet another advantage is obtained by the fact that the mode-selection line, in particular in expansion cards according to the PCMCIA standard, can be selected among several connection lines applicable for the purpose, because one of these lines is, depending on the purpose of use, usually not in use. After mode selection, the mode selection line can also be used for the original purpose, if necessary. When moving to a special operation mode, it is possible to define, if necessary, all the contact pins to function in a way different from the operation mode according to the standard, whereby the connection can be made simpler. Thus the electronic device to be used as a so-called hosta device can be simpler.

In the following, the invention will be described in more details, with reference made to the accompanying drawings, wherein

FIG. 1*a* shows a reduced block diagram of one prior art mode selection connection for an expansion card connected to a standard expansion-card interface,

FIG. 1*b* shows a reduced block diagram of one prior art mode selection connection for an expansion card connected to a non-standard expansion-card interface,

FIG. 2*a* shows, in accordance with one advantageous embodiment of the invention, a reduced block diagram of a mode selection connection for an expansion card connected to a standard expansion-card interface,

FIG. 2*b* shows, in accordance with one advantageous embodiment of the invention, a reduced block diagram of a mode selection connection for an expansion card connected to a non-standard expansion-card interface,

FIG. 2*c* shows, in accordance with one advantageous embodiment of the invention, a reduced block diagram of a mode-selection line wherein the mode-selection line can be selected by switches, and

FIG. 3 shows, in accordance with an advantageous embodiment of the invention, a reduced block diagram of an expansion-card interface as placed to the handset of the telephone.

The accompanying FIGS. 2*a* to 2*c* and 3 show only those blocks that are necessary for understanding the invention. In the embodiment according to FIG. 2*a*, the expansion card **1** is connected to an electronic device **2**, such as a portable computer comprising an expansion-card interface in accordance with the PCMCIA standard. The expansion card **1** can be any expansion card. The present description provides as an example an expansion card comprising an transmitter/receiver unit TX/RX of the mobile station. FIGS. 2*a* and 2*b* show in view of a connector **6** only a few connection lines, such as supply lines V_{cc1}, V_{cc2} for the operating voltage, supply lines V_{pp1}, V_{pp2} for the programming voltage, ground lines GND1 to GND4, starting line RST and the control line SPKR# for a loudspeaker. The address bus, data bus and other lines of a control bus are each shown as a separate arrow in the electronic device **2** and on the expansion card **1**. The control line SPKR# for the loudspeaker is, in view of the electronic device **2** that controls the expansion-card interface, an input line, i.e., the electronic device **2** does not control the line, but a pull-up resistance R2 is connected thereto. The examples of FIGS. 2*a* and 3*a* show a mode-selection line **3** connected in the connector **6** to the control line SPKR# of the loudspeaker. Other corresponding input lines in the PCMCIA standard are an interruption-request line IREQ, width-selection line IOIS16# of the I/O port, operation line WAIT# for wait states, and a state change line STSCHG# of the card, which lines can also be used as the mode-selection line **3** in accordance with the inventive idea of the present invention with the following preconditions.

The control line SPKR# of the loudspeaker can be used when the expansion card **1** does not transmit audio signals

to the electronic device **2**. The interruption-request line IREQ# can be used in case the expansion card **1** does not form interruption requests for the electronic device **2**. The width-selection line IOIS16# of the I/O port is applicable when the I/O port of the expansion card has a width of 8 bits. The operation line WAIT# for the wait states can be used in case no wait states are needed in the use of the expansion card **1**, i.e., the expansion card **1** can transmit data via the data bus sufficiently fast to the electronic device **2**. The state-change line STSCHG# of the card can be used e.g. with memory cards to indicate changes that have taken place in the memory state, wherein said state-change line cannot be used as the mode-selection line **3** on an expansion card of this kind. Further, Table 1 provides as a summary of the PCMCIA standard names, pin numbers and objects of use for said lines, as well as the situation in which the pin can be used as the mode-selection line **3**. Within the scope of the invention it is possible to use also other suitable lines as the above-mentioned ones for the input line of the electronic device **2**.

The connector **6** refers in this description both to a connector **6***a* of the electronic device **2** and a connector **6***b* of the expansion card **1**. The pins of the connector **6** are designated according to the PCMCIA standard, but the invention is applicable also in connection with other connection standards, wherein also the structure of the connectors and the order of the pins can be different.

TABLE 1

Name	Pin-number	Object of use	Use for the mode selection
SPKR#/BVD2	62	Loudspeaker signal	Loudspeaker is not needed
IREQ#	16	Request for interruption	No active interruptions
IOIS16#/WP	33	I/O port with 16 bits	I/O port with 8 bits
WAIT#	59	Lengthening of the bus period	Wait periods not needed
STSCHG#/BVD1	63	Change of card status	Status signals of the memory not used

The PCMCIA standard defines that the PCMCIA expansion card operates at the starting state in a corresponding manner as a memory card regardless of the type of the expansion card **1**. The electronic device **2** reads the information-structure database CIS as soon as the expansion card is mounted on its place. According to this information, the electronic device **2** knows which operations the expansion card **1** includes and how it is used. At this phase, the control line SPKR# for the loudspeaker of the extension-card interface of the electronic device **2** is used as the detector (BVD2) for the status of the battery, wherein the expansion card **1** can indicate to the electronic device **2** whether the battery of the expansion card **1** operates. However, a battery is not used in all the expansion cards, wherein a pull-up resistance R1 is advantageously connected to the line on the expansion card **1**. Further, the electronic device **2** should have a pull-up resistance R2 in the corresponding line.

The CIS database is advantageously stored to a non-volatile random access memory (NVRAM) **4**, which in this example is carried out by FLASH memory circuits. The CIS database is shown as memory at a given location. For example the PCMCIA standard includes a definition that the CIS database begins at an address **0** of the attribute memory. The reading of CIS database is carried out so that a processor **11** of the electronic device sets the initial address of the CIS database to the address lines A0 to A15 of the card interface; the control line DIR of the transfer direction to a state where the data transfer direction of the data lines D0 to D7 is from the card to the electronic device; the data-buffers-allowed line OE to a state where data buffers DBUFF are activated; and the data-reading line IORD to data-reading state. Thus, the first byte of the CIS database can be read in the data bus of the interface by the electronic device. The next byte is read according to a corresponding principle, by setting the address of the next byte to the address line. Said states of the control lines DIR, OE, IORD depend on the respective embodiment used, and they can be active low, which is known as such, i.e., a logic 0 state (voltage value about 0V in connection with common CMOS and TTL circuits) activates the function, or active high, i.e., a logic 1 state (about a voltage corresponding to the operating voltage in connection with common CMOS and TTL circuits) activates the function.

After reading the data of the card information structure CIS, the electronic device **2** sets the expansion card 1 to the I/O mode if the card used is an I/O type expansion card. Consequently, the control line SPKR# of the loudspeaker can be used for directing audio signals from the expansion card 1 to the electronic device **2**.

Correspondingly, on the expansion card **1** the mode selection means **5** reads the mode of the mode-selection line **3**. In FIG. **2***a* the expansion card is connected to an expansion-card connector **6** in an electronic device **2** comprising a standard expansion-card interface, wherein the pull-up resistance R1 coupled to the mode-selection line **3** and the pull-down resistance R2 of the electronic device set the line to a voltage value that substantially corresponds to the operating voltage V_{cc}, i.e., to the logic 1 state. Based on this, the mode selection means **5** sets the expansion card **1** to the special operation mode, which is a standard operation mode in this embodiment.

In FIG. **2***b* the expansion card **1** is connected to the expansion-card connector **6** in the electronic device **2** comprising an expansion-card interface that differs at least partially from the standard, in which expansion-card interface the pin corresponding to the control line SPKR# is connected to a ground potential. Thus, in spite of the pull-up resistance R1 coupled to the mode-selection line **3** the line is substantially at a voltage value corresponding to the ground potential, i.e., the logic 0 mode. Based on this the mode selection means sets the expansion card to the special operation mode which is a non-standard operation mode in this embodiment. When moving to a special operation mode, it is possible, if necessary, to define contact pins to function in a way different from that in the standard operation mode, whereby the connection can be made simpler. In some cases, even the re-setting of all the contact pins may come into question. Thus, the electronic device **2** used as the host device can be simpler.

Thus, the mode selection means **5** of the expansion card **1** reads the mode of the mode-selection line **3** after the card has been positioned to its place when the voltages are switched on, but also when the card is for some reason started again, i.e., by setting the logic 1 mode for a moment to a start line RST.

The mode selection is implemented advantageously only in connection with the start, and the mode selection means **5** preferably maintains the selected operation mode in use up to the next start, so that the mode-selection line **3** can be used also for other purposes after the mode selection by making respective changes to the switch and possibly also to the application software.

In the interface in accordance with the example of this embodiment, the first and second supply lines V_{cc1}, V_{cc2} for

the voltage are provided by means of two contact pins e.g. for effecting higher current supply capacity to the expansion card **1**. The power supply used is, in particular with portable electronic devices, a battery **7** which is charged by a charge device **8** if necessary. The electronic devices can further comprise a voltage compensation circuit **9**, such as a regulator and buffer means **10** for providing voltages required on the electronic device **2**. In view of the blocks of the electronic device, no supply lines for the operating voltage are illustrated, but this is technology known by an expert in the field as such. The control unit **11** of the electronic device comprises advantageously a microcontroller **11***a*, as shown in the circuit diagram of the electronic device in FIG. **2***b*. The control unit may comprise also a control logic circuit **11***b*, such as an ASIC circuit, as shown in FIG. **2***a*. The microcontroller **11***a*, and also the control logic circuit **11***b*, if necessary, attend e.g. to the operation of the expansion card interface and the transmission of signals to the expansion card **1** and the reading of signals provided by the expansion card. Timing signals for the control unit **11** are provided by a first oscillator **22**, e.g. by a crystal oscillator. Memory **21**, such as read only memory (ROM) or random access memory (RAM) is advantageously connected to the control unit of the electronic device.

In the electronic device **2** shown in FIG. **2***b*, data is transferred between the expansion card **1** and the electronic device **1** in serial form via a simple data line **23**. The electronic device **2** and the expansion card **1**, preferably the control unit **11**, **12**, are provided with means (not shown) for implementing data transmission in serial form, known as such. Data transmission in serial form has the advantage that fewer data transmission lines (data lines) will be required (usually one or two) than in data transmission in parallel form, but the transmission rate is lower, correspondingly.

In case it is preferred that the expansion card **1** is set to a special operation mode, the mode-selection line **3** has to be set to a mode corresponding thereto, said mode being the logic 0 state in the present embodiment, but in some embodiments this mode can be also e.g. the logic 1 state. The electronic device **2** can be e.g. a test apparatus having control and measuring electronics for testing the properties of the expansion card **1** or for locating defects. A pin corresponding to the mode-selection line of the connector **6** is thus connected to a different state than in a standard connector. Mode selection can also be implemented in a manner that by switches **S1**, **S2** (FIG. **2***c*) the connector line which operates as a mode-selection line in the interface card **1** to be connected at a time is set to a state corresponding to the special operation mode. The advantage of this arrangement is e.g. the fact that to the same connector **6** expansion cards **1** of various types can be connected e.g. for testing. As presented above in Table 1, the contact pin used as the mode-selection line **3** can vary according to the type of the expansion card **1**.

The mode selection means **5** is advantageously implemented in control logic **12** of the expansion card **1**, said control logic comprising with the most common PCMCIA cards a so-called SMART ASIC circuit **12***b*. An alternative embodiment is to use a microcontroller **12***a*, the mode-selection line **3** being directed to its I/O pin, wherein the reading of the mode-selection line **3** and the mode selection are carried out in the application software of the microcontroller **12***a* according to the state of said line. This technique is known to an expert in the field, wherein it is not necessary to describe it in more detail in this context.

Switches **S1**, **S2** can be mechanical switches, or also prior art semiconductor switches can be used, wherein the control of the switches can be implemented e.g. from the electronic device **2**, such as a test device. In the test device, selection means for various kinds of expansion cards **1** can be arranged for setting the switch **S1**, **S2** corresponding to the mode-selection line **3** and for implementing test measures according to the card type used.

Timing signals of the control logic of the expansion card are provided by a second oscillator **13**, e.g. a crystal oscillator.

FIG. **3** illustrates a reduced block diagram of an expansion-card interface in accordance with an advantageous embodiment of the invention, wherein the electronic device **2** is a handset **14** of a telephone, the expansion-card interface of said handset being at least partially different from the PCMCIA standard. The telephone can be e.g. a mobile station, such as a GSM mobile station. The handset **14** advantageously includes a microphone **15**, earphone **16**, display driver **17***a*, display **17***b* and keypad **18**. The expansion card **1** can be connected to the expansion-card connector **6***a*, e.g. by pushing it through an opening (not shown) provided in the handset **14**. The microphone **15** is coupled to a microphone contact pin MIC of the expansion-card connector **6***a* through a microphone amplifier **19**, and the earphone **16** is coupled to the earphone contact pin EAR of the expansion-card connector **6***a* through an earphone amplifier **20**. In the expansion card **1**, the microphone and earphone lines are directed to the transmitter/receiver unit TX/RX. The display driver **17***a* and the keypad **18** are connected to the control unit **11**, wherein the application software in the microprocessor **11***a* of the control unit attends to that the controls from the keypad are transferred to the expansion card **1** and, in a corresponding manner, that the display messages from the expansion card **1** are transferred via the display driver **17***a* to the display **17***b*. The transfer of signals can be e.g. parallel, as in the embodiment shown in FIG. **3**, or also serial form data transfer can be used between the electronic device **2** and the expansion card **1**.

To the transmitter/receiver unit TX/RX the operating voltage is taken from the supply pins V_{pp1}, V_{pp2} of the programming voltage, because the power consumption of the transmitter/receiver unit TX/RX can rise high enough for the maximal allowable current intensity of the supply pins V_{pp1}, V_{pp2} of the programming voltage to be exceeded, if the operating voltage of the transmitter/receiver unit TX/RX were taken from the supply pins V_{pp1}, V_{pp2} of the programming voltage.

An interface card having more than one special operation mode has also more than one mode-selection lines **3**. Thus, the logic modes of the mode-selection lines are set to modes corresponding to the desired operation mode. Table 2 illustrates one example wherein the expansion card has eight operation modes: one normal operation mode and seven special operation modes. Thus, for selecting the eight possible operation modes, at least three mode-selection lines (2^3=8) are required, each of which can be set to two logic states (0/1). The mode-selection lines used are e.g. the control line SPKR# of the loudspeaker, interruption-request line IREQ# and width-selection line IOIS16# for the I/O port. Prefers to a normal operation mode and X1 to X7 refer to special operation modes. The normal operation mode P is selected by setting all the mode-selection lines SPKR#, IREQ#, IOIS16# to the logic 1 state. The first special operation mode X1 is selected by setting the first mode-selection line, i.e., in this situation the control line SPKR# of the loudspeaker, to the logic 0 state while the other mode-selection lines IREQ#, IOIS16# are in the logic 1 state. In a corresponding manner, a second special operation mode X2

is selected by setting a first mode-selection line SPKR# and a third mode-selection line, which in this example is the width-selection line IOIS16# of the I/O port, to a logic 1 state and the interruption-request line IREQ# used as a second mode-selection line to the logic 0 state. The logic states (0/1) of the mode-selection lines SPKR#, IREQ#, IOIS16# for selecting also other special operation modes X3 to X7 are illustrated in Table 2.

TABLE 2

Mode-selection	Operation mode							
line	P	X1	X2	X3	X4	X5	X6	X7
SPKR#	1	0	1	0	1	0	1	0
IREQ#	1	1	0	0	1	1	0	0
IOIS16#	1	1	1	1	0	0	0	0

It should further be mentioned that more than one mode-selection lines **3** can be used also in situations in which the number of the operation modes to select between is only two. Thus, e.g. the normal operation mode is selected when all the mode-selection lines are at the logic 1 state, and the special operation mode is selected when at least one mode-selection line is at the logic 0 state. Also other combinations of mode-selection lines are possible for carrying out the selection of two operation mode.

The present invention is not restricted solely to the embodiments presented above, but it can be modified within the scope of the accompanying claims. E.g. the electronic device **2** used can be other than those introduced above. The reference numerals of the contact pins and other elements referred in the accompanying claims are mentioned only as clarifying examples, but the invention is not restricted solely thereto.

One advantageous embodiment of the expansion card **1** comprises at least a power amplifier of a mobile station, such as a GSM mobile station.

What is claimed is:

1. An expansion card comprising at least one expansion-card connector for connecting the expansion card to a second expansion-card connector of an electronic device, said expansion card having at least a standard normal operation mode and one or several special operation modes that differ from the standard normal operation mode, and the operation mode of said expansion card being arranged to be selected by at least one mode-selection line, wherein:

the mode-selection line is combined to a contact pin of the one expansion-card connector which contact pin has a respective contact pin for the second expansion-card connector of the electronic device,

said respective contact pin being defined as the input line of the electronic device in said standard normal operation mode, and

the mode selection line is arranged to be used, if necessary, for the original purpose after the mode selection.

2. An expansion card as set forth in claim **1**, wherein the standard normal operation mode is the PCMCIA standard.

3. An expansion card as set forth in claim **1**, wherein said one mode-selection line is connected to at least one of a control line for a loudspeaker, an interruption-request line, a width-selection line of an I/O port, an operation line for wait states, and a state-change line for the expansion card, said lines belonging to an expansion-card connector.

4. An expansion-card interface for an electronic device, said expansion-card interface comprising at least one expansion-card connector for connecting an expansion card to the electronic device, said expansion card having at least a standard normal operation mode and one or several special operation modes which differ, at least partially, from said standard normal operation mode, and the operation mode of said expansion card is arranged to be selected at least by one mode-selection line, wherein:

a contact pin of the expansion-card interface is arranged as the mode-selection line, which in said standard normal operation mode is defined as the input line of the electronic device, and

the mode selection line is arranged to be used, if necessary, for the original purpose after the mode selection.

5. An expansion-card interface as set forth in claim **4**, wherein the standard normal operation mode is the PCMCIA standard.

6. An expansion-card interface as set forth in claim **4**, wherein said expansion-card interface comprises a control line for a loudspeaker and said one mode-selection line is connected to the control line for a loudspeaker of the expansion-card interface.

7. An expansion card interface as set forth in claim **4**, characterized in that said one mode-selection line is connected to at least one of a control line for a loudspeaker, an interruption-request line, a width-selection line of an I/O port, an operation line for wait states, and a state-change line for the expansion card, said lines belonging to said expansion-card connector.

8. An electronic device comprising at least one expansion-card interface for connecting an expansion card to said electronic device, said expansion card having at least a standard normal operation mode and one or several special operation modes which differ at least partially from said standard normal operation mode, and the operation mode of said expansion card being arranged to be selected by at least one mode-selection line, wherein:

a contact pin of the expansion-card interface is arranged as the mode-selection line, which in said standard normal operation mode is defined as the input line of the electronic device, and

the mode selection line is arranged to be used, if necessary, for the original purpose after the mode selection.

9. An electronic device as set forth in claim **8**, comprising an expansion-card interface according to the PCMCIA standard.

10. An electronic device as set forth in claim **8**, comprising means for setting the mode-selection line of the expansion card to a state corresponding to the standard normal operation mode.

11. An electronic device as set forth in claim **8**, comprising means for setting the mode-selection line of the expansion card to correspond to the state of the special operation mode.

12. An electronic device as set forth in claim **10**, wherein the state corresponding to the standard normal operation mode of the mode-selection line is the logic 1 state and the state corresponding to the special operation mode of the mode-selection line is the logic 0 state.

13. An electronic device as set forth in claim **7**, characterized in that said one mode-selection line is connected to at least one of a control line for a loudspeaker, an interruption-request line, a width-selection line of an I/O port, an operation line for wait states, and a state-change line for the expansion card, said lines belonging to said expansion-card interface.

* * * * *

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United States Patent [19]

Parulski et al.

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[45] Date of Patent: Dec. 12, 1995

[54] **ELECTRONIC CAMERA WITH MEMORY CARD INTERFACE TO A COMPUTER**

[75] Inventors: **Kenneth Parulski**; **Raymond J. Bouvy**, both of Rochester; **Timothy J. Tredwell**, Fairport; **David A. Smith**, Rochester, all of N.Y.

[73] Assignee: **Eastman Kodak Company**, Rochester, N.Y.

[21] Appl. No.: **988,517**

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[51] **Int. Cl.**[6] **H04N 5/30**

[52] **U.S. Cl.** **348/552**; 348/207; 348/158

[58] **Field of Search** 358/209, 41; 354/412; 348/207, 552, 158; 395/425; H04N 5/30

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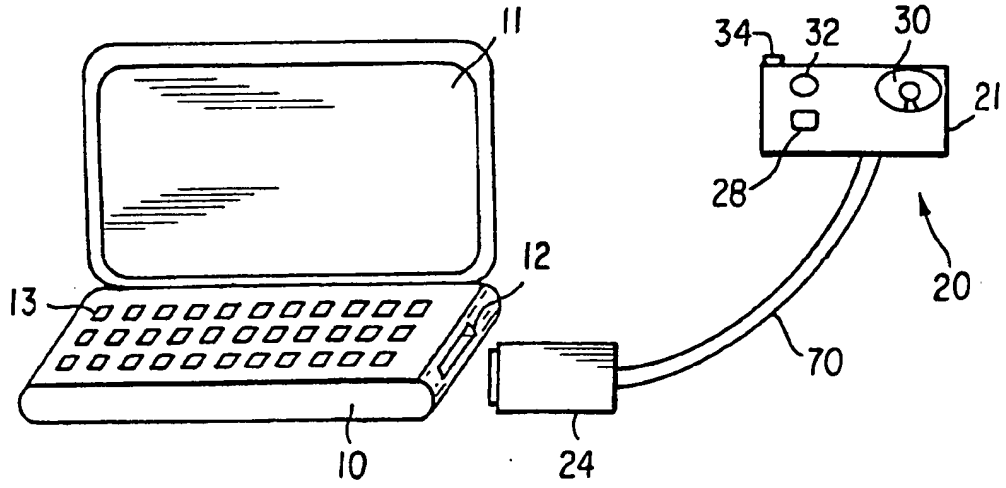
Primary Examiner—Michael T. Razavi
Assistant Examiner—Andy Christensen
Attorney, Agent, or Firm—David M. Woods

[57] **ABSTRACT**

An electronic camera operates with a small, portable computer having a card interface of the type used for communicating with a removable memory card. The camera includes an image sensor for converting an image into an electrical signal, an A/D converter for converting the electrical signal into a digital signal, and a signal processor for interfacing the digital signal to the card interface, ordinarily a slot receptacle, on the computer. By defining the interface to include a mechanical extender that physically interconnects the camera to the card slot on the computer, the camera and computer are linked in a high speed interface as a convenient, hand-held unit.

10 Claims, 5 Drawing Sheets



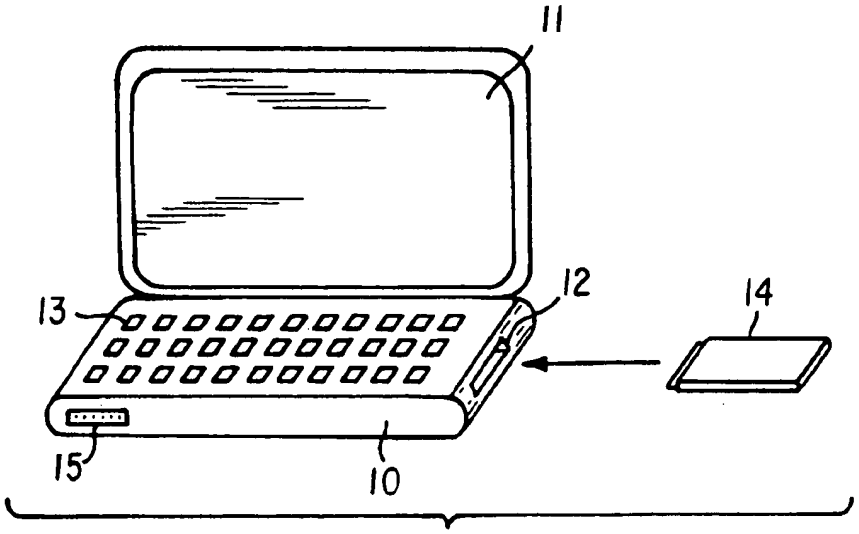


FIG. 1
(prior art)

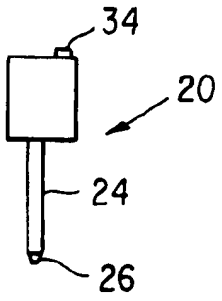


FIG. 2B

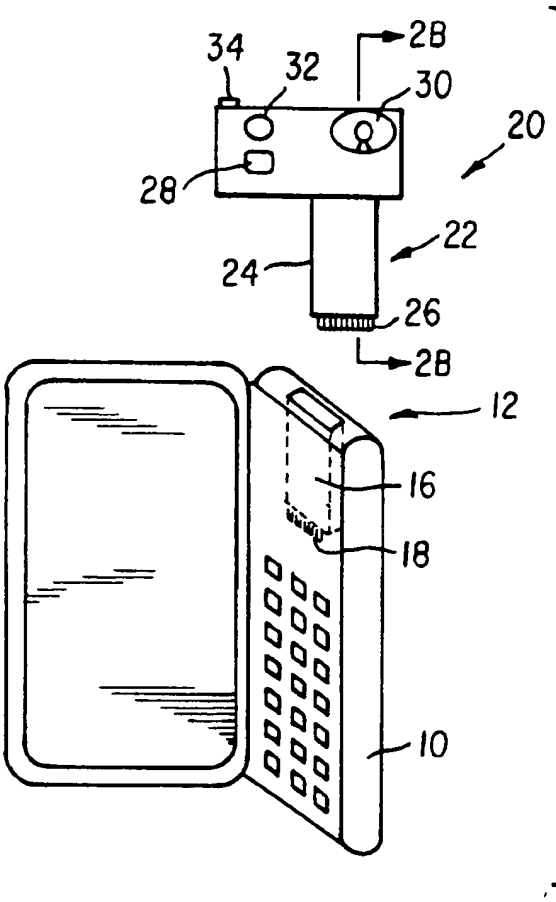


FIG. 2A

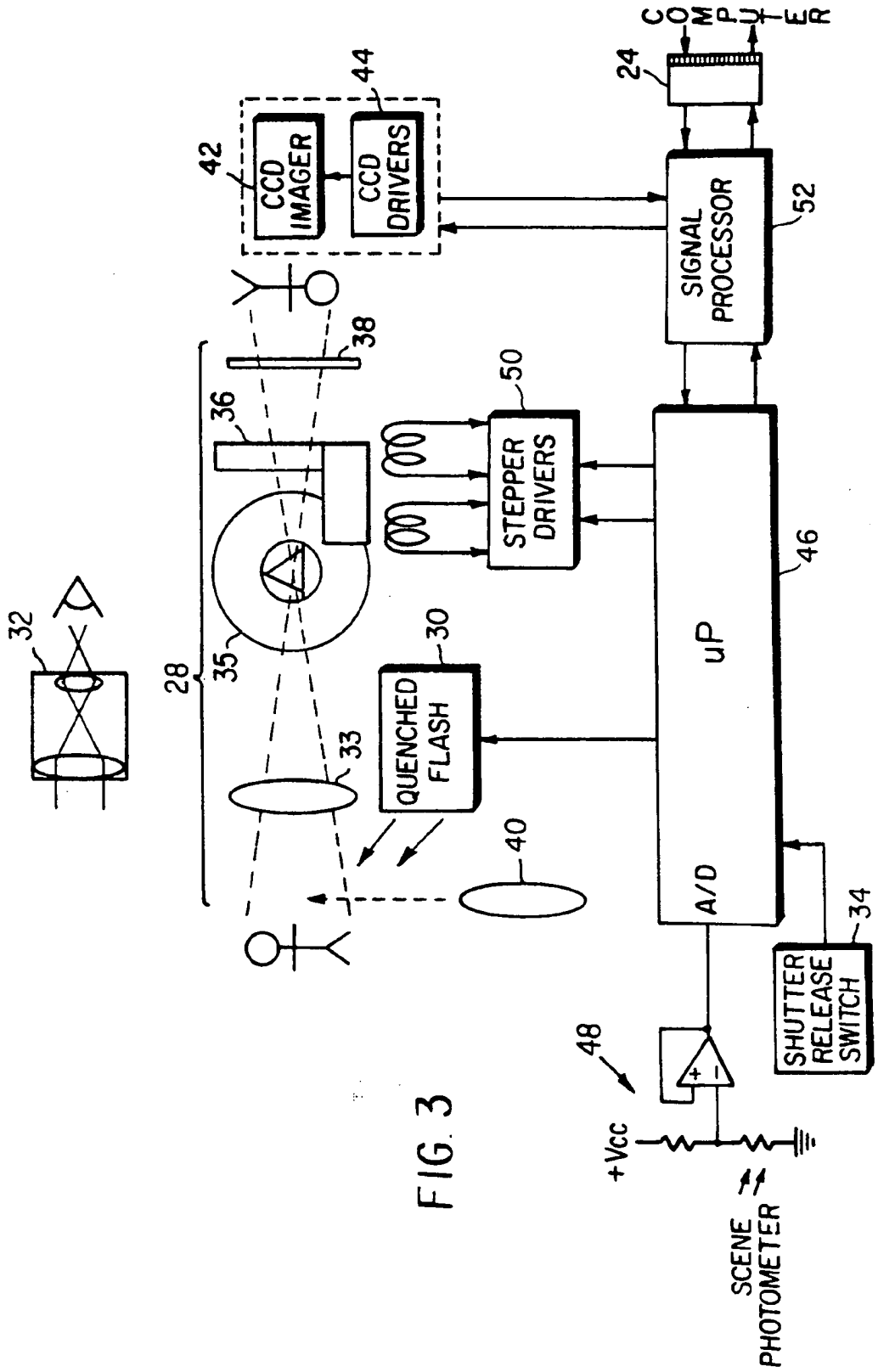

COMPUTER
24
44
42
CCD IMAGER
CCD DRIVERS
SIGNAL PROCESSOR
52
38
36
50
STEPPER DRIVERS
46
uP
32
28
35
30
QUENCHED FLASH
33
40
A/D
34
SHUTTER RELEASE SWITCH
48
+Vcc
SCENE PHOTOMETER

FIG. 3

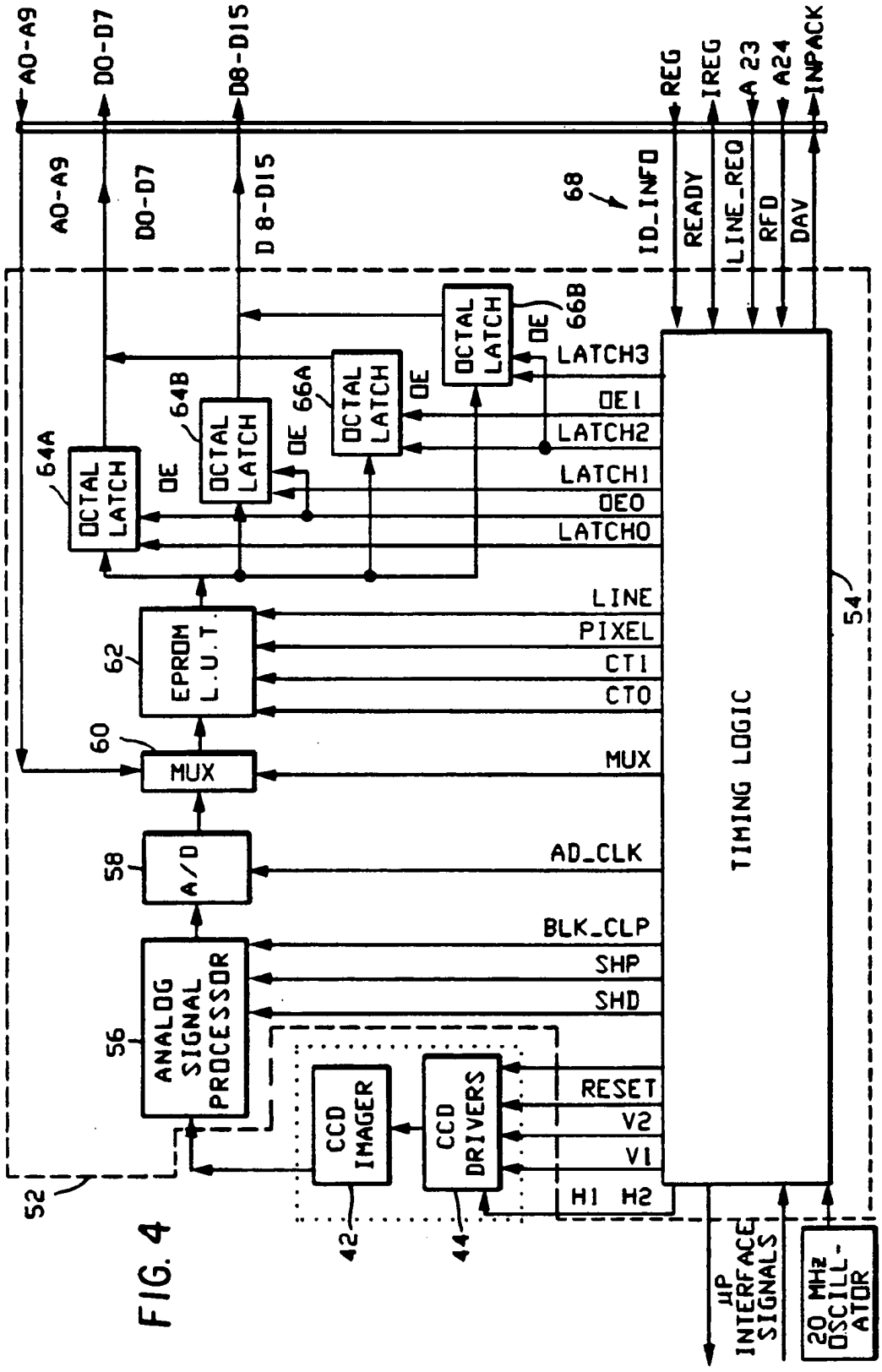

A0-A9
D0-D7
D8-D15
REG
IREG
A 23
A24
INPACK
A0-A9
D0-D7
D 8-D15
68
ID_INFO
READY
LINE_REQ
RFD
DAV
OCTAL LATCH
66B
OE
LATCH3
OCTAL LATCH
64B
OE 66A
OCTAL LATCH
OE
OEI
LATCH2
64A
OCTAL LATCH
OE
LATCH1
OEO
LATCH0
LINE
PIXEL
CTI
CTO
62
EPROM L.U.T.
54
60
MUX
MUX
58
A/D
AD_CLK
TIMING LOGIC
BLK_CLP
SHP
SHD
56
ANALOG SIGNAL PROCESSOR
CCD IMAGER
CCD DRIVERS
RESET
V2
V1
H1 H2
52
42
44
µP INTERFACE SIGNALS
20 MHz OSCILL-ATOR

FIG. 4

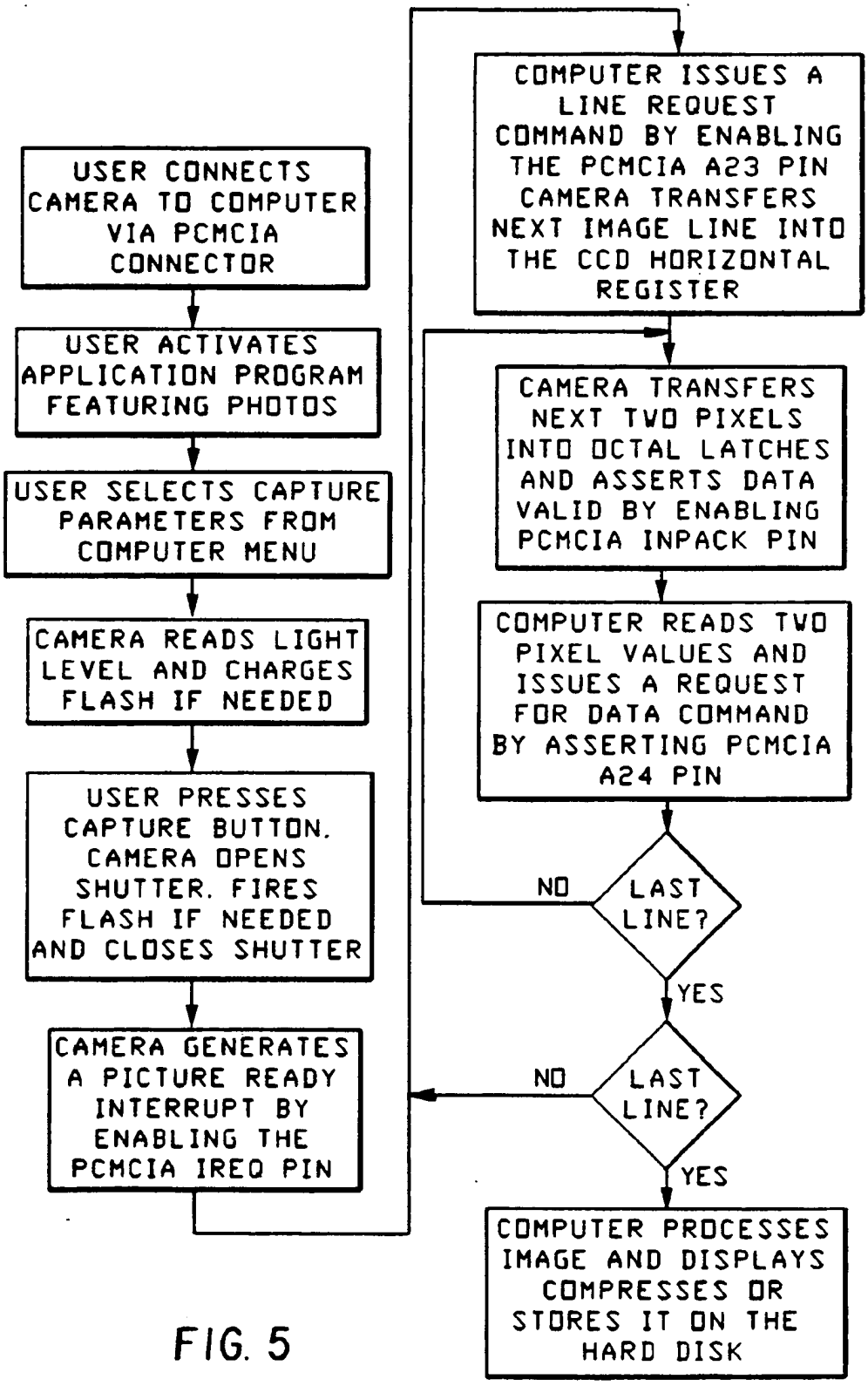

USER CONNECTS CAMERA TO COMPUTER VIA PCMCIA CONNECTOR
USER ACTIVATES APPLICATION PROGRAM FEATURING PHOTOS
USER SELECTS CAPTURE PARAMETERS FROM COMPUTER MENU
CAMERA READS LIGHT LEVEL AND CHARGES FLASH IF NEEDED
USER PRESSES CAPTURE BUTTON. CAMERA OPENS SHUTTER. FIRES FLASH IF NEEDED AND CLOSES SHUTTER
CAMERA GENERATES A PICTURE READY INTERRUPT BY ENABLING THE PCMCIA IREQ PIN
COMPUTER ISSUES A LINE REQUEST COMMAND BY ENABLING THE PCMCIA A23 PIN CAMERA TRANSFERS NEXT IMAGE LINE INTO THE CCD HORIZONTAL REGISTER
CAMERA TRANSFERS NEXT TWO PIXELS INTO OCTAL LATCHES AND ASSERTS DATA VALID BY ENABLING PCMCIA INPACK PIN
COMPUTER READS TWO PIXEL VALUES AND ISSUES A REQUEST FOR DATA COMMAND BY ASSERTING PCMCIA A24 PIN
LAST LINE?
NO
YES
LAST LINE?
NO
YES
COMPUTER PROCESSES IMAGE AND DISPLAYS COMPRESSES OR STORES IT ON THE HARD DISK

FIG. 5

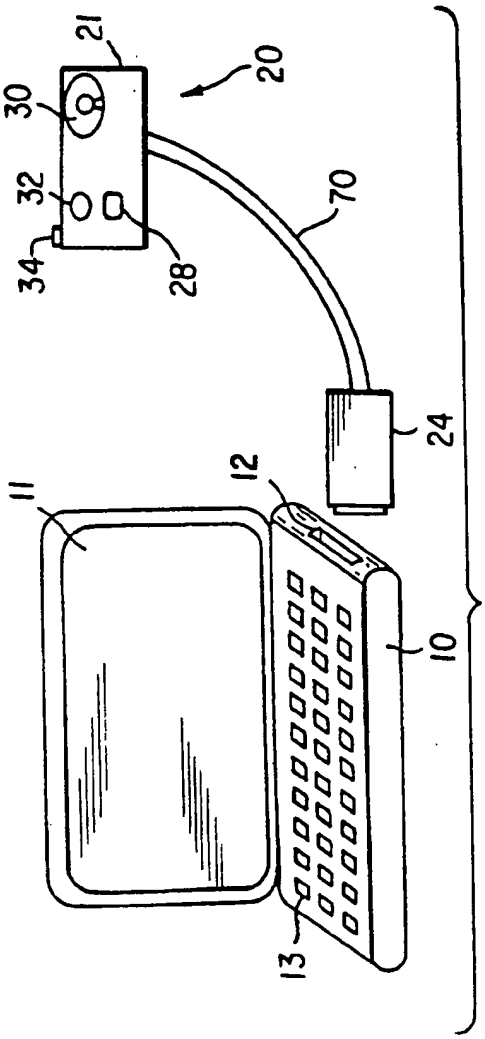

21
20
30
32
34
28
70
24
12
11
10
13

FIG. 6

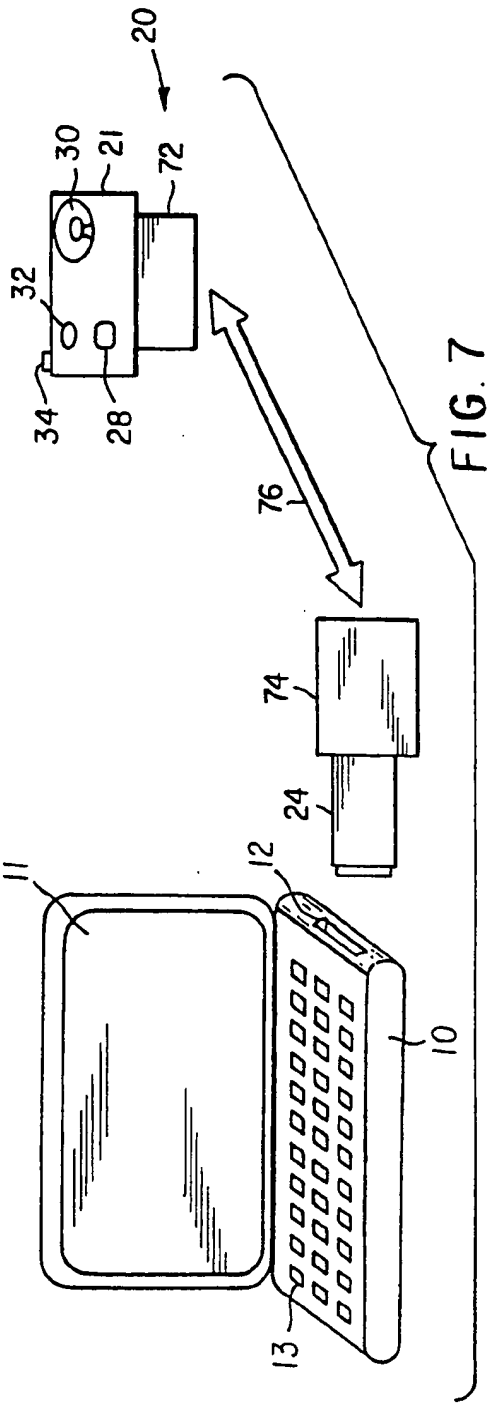

20
30
21
72
32
34
28
76
74
24
12
11
10
13

FIG. 7

ELECTRONIC CAMERA WITH MEMORY CARD INTERFACE TO A COMPUTER

FIELD OF THE INVENTION

This invention pertains to the field of electronic imaging and, more particularly, to an image acquisition peripheral operated as an input device to a personal computer.

BACKGROUND OF THE INVENTION

It is well known to use a video camera with a computer frame grabber. A typical system employs a video motion camera (such as the CCD 4000 RGB Flash-Sync Camera manufactured by Eastman Kodak Co., Rochester, N.Y.) and a frame grabber board (such as a TARGA™ frame store board manufactured by True Vision, Inc., Indianapolis, Ind.) attached to the PC bus of a personal computer. The camera provides the timing to interface with the video frame store board by activating the frame acquire line of the frame store board whenever an external voltage input to the camera is dropped low (e.g., by dropping the "Camera Acquire In" line to the CCD 4000 camera). It is customary to design software to activate the camera's frame acquire line from the computer. To capture an image into the computer in such a customary application, the operator frames the subject while observing the live camera output on a video monitor, and then interacts with the computer keyboard at the proper moment.

Another approach to computer image acquisition is described in U.S. Ser. No. 805,220, entitled "Hand-Manipulated Electronic Camera Tethered to a Personal Computer," which was filed Dec. 11, 1991 in the names of K. A. Parulski, R. H. Hamel, and J. J. Acello, and assigned to the assignee of the present application. In this system an electronic camera is coupled to a personal computer through a computer interface. In particular, a digital interface standard may be used, and images from the camera are input to the computer through a Small Computer System Interface (SCSI). The camera is preferably linked, or tethered, to the computer with a cable, thus allowing a certain amount of mobility for the camera independent of the computer.

Both of these known interfaces have drawbacks. The NTSC signal is an analog signal subject to noise, and additionally requires a special frame grabber card in the computer to decode and digitize the signal. The SCSI signal has a relatively low data rate and a complicated protocol, requiring an expensive SCSI interface integrated circuit in the camera. Notwithstanding such drawbacks, the system described in Ser. No. 805,220 provides a low cost electronic still camera which attaches to a personal computer that provides image processing, storage, and display. By relying on the computer to perform these tasks, the camera cost can be greatly reduced.

It is known to provide detachable integrated circuit memory in the size and form of a thin card, much like a credit card, that is connectable to a memory card reader which interfaces to a host data processing system via a standard interface, such as the SCSI interface. A typical general-purpose host system, such as a desktop computer, incorporates a processor for utilizing data recorded on the memory card in a variety of applications; a typical specialized host system, e.g., an image capture processing system, provides large volumes of digital data for rapid recording on the card. Newer, smaller, battery-operated personal computers (such as notebook or penpad personal computers) utilize a memory card controller (such as the MB86301 Memory Card Controller, by Fujitsu Microelectronics, Inc.) that is compatible with the Personal Computer Memory Card International Association (PCMCIA) standard. Such a controller is capable of interfacing a variety of memory cards, with densities up to 64 Mbytes, to a wide range of microprocessors via 8- or 16-bit data paths. A typical application is shown in FIG. **1**, where a small, battery-operated computer **10** includes a card receptacle **12** for accepting a memory card **14**. These computers are often ergonomically designed so that the display screen **11** folds over the keyboard **13**, making a very compact package. In such a computer the memory card **14** takes the place of a floppy disk drive. Such small computers often have an RS-232 input port **15**, but seldom have either a SCSI port or a dedicated video input port. Images can be input via the RS-232 port **15**, but this is a very slow process.

A memory card may also be used as the removable storage medium for recording images taken by an electronic still camera. An example of such a system is shown in U.S. Pat. No. 5,016,107, wherein an image sensor generates analog image information that is converted into digital signals, transformed, and encoded into a compressed stream of digital signals that are downloaded to a removable memory card. The memory card disclosed therein includes a commercially-available high speed static random access memory (SRAM). In another configuration of interest, which is shown in U.S. Pat. No. 4,937,676, a compact, handheld portable electronic imaging system includes both an electronic imaging camera and a hard copy printer (and display) that are separately housed with respect to each other yet readily interconnectable for use either in combination or apart. The camera and printer interconnect by means of an elongated tongue member on the printer housing that slides into a recessed groove in the camera housing. Electrical connectors in the tongue-groove interface convey image signals between the camera and the printer. In addition to the tongue-groove interface between the camera and the printer, slots are provided on the respective units to accept memory cards for separate storage and retrieval of the image signals.

In all of these systems, there is need for a low cost means of digitally interfacing a small camera peripheral to a portable computer at a rate higher than that provided by a SCSI interface or an RS-232 input, and without the attendant difficulties of an analog frame grabbing process.

SUMMARY OF THE INVENTION

An object of the invention is to adapt an available, convenient, high speed interface on a small, portable computer to an electronic camera.

In accordance with the invention, an electronic camera operates with a computer having a card interface of the type used for communicating with a removable card containing semiconductor memory. For this purpose, the camera includes means for converting an image into an electrical signal, means for converting the electrical signal into a digital signal, and means for interfacing the digital signal to the card interface on the computer. By further defining the interfacing means to include a mechanical adaptor that physically interconnects the camera to a card slot on a portable computer, the structural connection links the camera and computer together as a hand-held unit. In a preferred embodiment, the card interface incorporates the PCMCIA standard.

The advantage of the invention is that the camera can be designed as an inexpensive "clip-on" accessory that mates

with a portable computer incorporating a PCMCIA "memory card" slot. The computer can be thus relied upon to perform image processing, storage, and display. The PCMCIA interface provides a high speed parallel interface for rapidly transferring image data from an image sensor to a personal computer.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in relation to the drawings in which

FIG. **1** is an illustration of a known computer adapted for use with a memory card;

FIG. **2A** is an illustration of an electronic still camera adapted for insertion into the card slot of a computer in accordance with the invention;

FIG. **2B** is a side elevation of the camera of FIG. **2A** taken along the lines **2B—2B**;

FIG. **3** is block diagram of the major elements of the camera of FIG. **2A**;

FIG. **4** is a more detailed diagram of the signal processor shown in FIG. **3**;

FIG. **5** is a flow chart showing the operation of the electronic still camera shown in the aforementioned Figures;

FIG. **6** is a second embodiment of an electronic still camera employing a card interface; and

FIG. **7** is a third embodiment of an electronic still camera employing a card interface.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Since electronic still cameras and computers, including small computers utilizing a card slot adapted to a PCMCIA standard, are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. Elements not specifically shown or described may be selected from those known in the art. In particular, information as to a typical card interface standard can be found in the *PC Card Standard, Release* 2.0, published by the Personal Computer Memory Card International Association, Sunnyvale, Calif. September 1991.

Referring to FIG. **2**, and in accordance with one embodiment of the invention, an electronic camera **20** incorporates a structural element **22** which allows the camera **20** to be connected into the conventional memory card receptacle **12** of a portable computer **10**. The receptacle **12** is, e.g., a slot **16** for receipt of a card containing semiconductor memory and the structural element **22**, in that case, is an extender board **24** that fits into the slot **16** (shown in phantom lines). The extender **24** includes an edge connector **26** that is configured to mate with a corresponding connector **18** (shown in phantom lines) within the slot **16** when the camera **20** is properly located in relation to the computer **10**. (While not critical to the invention, the extender board **24** can be removable from the camera **20**, or can be folded into or parallel to the camera **20** when detached from the computer **10**.)

Preferably, the card interface is the PCMCIA memory card interface described in the aforementioned reference. In accordance with the PCMCIA PC Card Standard—Release 2.0, the interface pin assignments are as follows (Table I):

TABLE I

PCMCIA PC CARD STANDARD - RELEASE 2.0
PIN ASSIGNMENTS

PIN	SIGNAL	I/O	FUNCTION
1	GND		Ground
2	D3	I/O	Data bit 3
3	D4	I/O	Data bit 4
4	D5	I/O	Data bit 5
5	D6	I/O	Data bit 6
6	D7	I/O	Data bit 7
7	CE1	I	Card enable
8	A10	I	Address bit 10
9	OE	I	Output enable
10	A11	I	Address bit 11
11	A9	I	Address bit 9
12	A8	I	Address bit 8
13	A13	I	Address bit 13
14	A14	I	Address bit 14
15	WE/PGM	I	Write enable
16	IREQ	O	Interrupt Request
17	Vcc		
18	Vpp1		Programming and Peripheral Supply
19	A16	I	Address bit 16
20	A15	I	Address bit 15
21	A12	I	Address bit 12
22	A7	I	Address bit 7
23	A6	I	Address bit 6
24	A5	I	Address bit 5
25	A4	I	Address bit 4
26	A3	I	Address bit 3
27	A2	I	Address bit 2
28	A1	I	Address bit 1
29	A0	I	Address bit 0
30	D0	I/O	Data bit 0
31	D1	I/O	Data bit 1
32	D2	I/O	Data bit 2
33	IOIS16	O	IO Port is 16 bit
34	GND		Ground
35	GND		Ground
36	CD1	O	Card detect
37	D11	I/O	Data bit 11
38	D12	I/O	Data bit 12
39	D13	I/O	Data bit 13
40	D14	I/O	Data bit 14
41	D15	I/O	Data bit 15
42	CE2	I	Card enable
43	RFSH	I	Refresh
44	IORD	I	IO Read
45	IOWR	I	IO Write
46	A17	I	Address bit 17
47	A18	I	Address bit 18
48	A19	I	Address bit 19
49	A20	I	Address bit 20
50	A21	I	Address bit 21
51	Vcc		
52	Vpp2		Programming and Peripheral Supply 2
53	A22	I	Address bit 22
54	A23	I	Address bit 23
55	A24	I	Address bit 24
56	A25	I	Address bit 25
57	RFU		Reserved
58	RESET	I	Card Reset
59	WAIT	O	Extend bus cycle
60	INPACK	O	Input Port Acknowledge
61	REG	I	Register select & IO Enable
62	SPKR	O	Audio Digital Waveform
63	STSCHG	O	Card Statuses Changed
64	D8	I/O	Data bit 8
65	D9	I/O	Data bit 9
66	D10	I/O	Data bit 10
67	CD2	O	Card detect
68	GND		Ground

The camera **20** is thus connected into the **68** pin PCMCIA memory card slot **16** of the portable computer **10** by means of an extender board **24** that matches PCMCIA card dimensions. The full PCMCIA dimensions are available in the aforementioned Release 2.0; basically, the card is approxi-

mately 86 mm long by 54 mm wide by 4 mm thick. The card slot **16** is dimensioned accordingly. The camera **10** is designed to respond to commands from the portable computer **10** using the normal PCMCIA address and control lines, and to provide image data to the computer **10** over the normal PCMCIA data lines, as shown in Table I. The camera includes memory which defines the "card" as a "camera", and can optionally store the compiled software code for the computer **10** to execute in order to properly process images from the camera **20**. One advantage of the invention is that the camera can be designed as an inexpensive accessory to the computer, with a minimum of external components. In FIG. **2**A, the camera **20** is shown with an optical system **28**, a flash unit **30**, a view finder **32**, and a capture switch **34**. As shown in side elevation in FIG. **2**B, the camera **20** can be made to have a relatively thin configuration that ergonomically mates with the computer **10**. In this manner the computer **10** and camera **20** interconnect via the PCMCIA card slot **16** to form a convenient hand-held unit for taking pictures.

FIG. **3** shows the subsystems of the camera **10**. The optical system **28** includes a lens **33**, a diaphragm **35**, a shutter **36**, and an infrared filter **38**. To keep the system inexpensive, the lens **33** is fixed focus, and a close-up diopter lens **40** is optionally moved into the optical axis for close-up pictures. Image light is directed by the optical system **28** upon an image sensor **42**, which is a charge-coupled device (CCD) sensor, such as the full frame sensor KAF-400 manufactured by Eastman Kodak Company, Rochester, N.Y. The timing of the read-out of the image sensor **42** is controlled by a CCD clock driver circuit **44**.

The sub-systems of the camera **20** are controlled by a microprocessor **46**. In particular, the exposure conditions of the image are input to the microprocessor **46** from a photometer **48** and shutter release is initiated by the capture switch **34**. Accordingly, the microprocessor **46** instructs a pair of stepper drivers **50** to set the diaphragm **35** and to operate the shutter **36**, and, as needed, to fire the flash **30**. The microprocessor **46** further interfaces with a signal processor **52**, which controls the read-out clocking of the image sensor **42** and processes the image signal generated by the image sensor **42**. The signal processor **52** provides the processed image signals to the computer **10** via the extender **24**.

Details of the signal processor **52** are shown in FIG. **4**. A logic circuit **54** (such as Model EPS464 or Model EPM7096 integrated circuits manufactured by Altera Corp., San Jose, Calif.) provides the timing signals to control the image sensor **42** and the various parts of the signal processor **52**. In particular the logic circuit **54** provides the horizontal and vertical clocking signals H1, H2, V1, V2 to read an image signal from the sensor **42** and the timing signal RESET to initiate each pixel read-out period. The output of the sensor **42** is initially processed by an analog signal processor **56** incorporating, e.g., a gain stage and a correlated double sampling circuit, and converted to a digital signal by an analog-to-digital (A/D) converter **58**. The digitized signal is then processed by an EPROM look-up table (LUT) **62** that is addressed by a multiplexer **60**. The LUT **62** stores the white balance and gamma correction curveshapes, and information about the camera. More particularly, the LUT **62** may store the Card Information Structure (CIS) required by the PCMCIA format (refer to the aforementioned PCMCIA standard reference), which indicates that the computer is accessing a special type of "memory card", specifically, a "camera". The LUT can also store a camera serial number, location of sensor defects, the structure of a color filter array used on the sensor **42**, etc. Moreover, the LUT **62** may also store the computer program which is used (by the computer) to operate the camera and to process the images from the sensor color filter array to obtain a full resolution, color corrected image. This information is read from EPROM **62** when the REG pin on the PCMCIA connector is enabled, causing the timing logic **54** to switch the MUX**60** output to respond to address pins A**0**–A**9** on the PCMCIA connector.

The digitized signal processed by the LUT **62** is then provided to two sets of octal latches, **64***a*, **64***b*, and **66***a*, **66***b*. Each octal latch stores one pixel value. While one set (**64***a*, **64***b* or **66***a*, **66***b*) of latches is being loaded, the pixel values stored in the other set from the previous two pixels are read into the computer **10** through the 16-bit data lines D**0**–D**15** via the PCMCIA bus. The camera **20** is controlled by the address lines A**0**–A**9** and the control lines **68** from the computer **10** provided via the PCMCIA bus. In addition to the already-mentioned REG pin, which is used to initiate a readout of information from the LUT **62**, the IREQ line receives a signal from the timing logic **54** when data is available for transfer, and address bit **23** (A**23** pin) is set by the computer to trigger the timing logic **54** to begin a line transfer. As each pair of pixels are latched into the octal latches **64***a*, **64***b*, **66***a*, and **66***b*, the timing logic **54** indicates that valid data is available by asserting the INPACK pin. After the computer has read the two pixel values, it asserts address bit **24** (A**24** pin) to alert the timing logic 54 that the computer is ready for another two pixels. This two-pixel by two-pixel "hand shaking" continues until the full line is transferred, and the process then repeats for the next line.

The operation of the image capture system of FIGS. **2**-**4** proceeds as shown in the flow chart of FIG. **5**. The user begins by connecting the extender card **24** incorporating the PCMCIA socket **26** to the camera, and sliding the extender card **24** into the computer. The user opens a "camera" application program and selects capture parameters from a menu. The options can include color (8, 16, or 24 bit) or monochrome (1 or 8 bit), full resolution or subsampled, and store direct to disk, compress before storing, or convert to a standard metric before storing. Once the selections are made, the camera **20** is "enabled" and the flash is charged if required. The user frames the image and depresses the capture button **34**. This action initiates a sequence in which the scene light level is read using the photometer **48**, the diaphragm **35** is adjusted, the shutter **36** is opened, the flash **30** is fired if necessary, and the image sensor **42** is exposed to light. The digitized image sensor data, a line at a time, is read over the PCMCIA bus to the computer RAM memory using the sequence shown in FIG. **5**. Depending on the capture options selected, the data is either stored directly from RAM to the hard disk (or other non-volatile computer memory), is compressed using conventional methods, or converted to a full resolution color image.

In a second embodiment shown in FIG. **6**, the camera **20** includes an enclosure **21** connected to the extender board **24** via a flexible multi-wire cable **70** (the enclosure **21** includes the elements of FIG. **4** less the extender board **24**.) The extender board **24** plugs into the PCMCIA slot **12** in the computer **10**. The cable **70** allows the camera **20** to be used some distance from the computer. The multi-wire cable may include only a subset of the pin connections listed in table 1, since pins not used by the camera **20** do not need to be included in the cable **70**. To further reduce the number of wires required, the cable could use a serial data format, and the serial data could be converted to parallel data on the extender board **24**.

In a third embodiment shown in FIG. **7**, the camera **20** includes a radio frequency (RF) element **72** having an RF

transmitter and an RF receiver connected to the enclosure **21**, and the extender board **24**, which plugs into the PCMCIA slot **12** in the computer **10**, also includes an RF element **74** having an RF transmitter and receiver. The digital image is transferred from the camera **20** to the computer **10** via an RF link **76**, which is shown schematically by an arrow. Alternately, an infrared (IR) transmission link could be used, and the elements **72** and **74** would constitute respective sets of infrared (IR) emitters and receivers.

The invention has been described in detail with particular reference to a presently preferred embodiment, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention. For example, in another embodiment, the camera **20** could supply data using only 8 bits out of the 16 data bits available on the PCMCIA connector. In yet another embodiment, a buffer memory may be inserted between the LUT 62 and the PCMCIA connector so that the data transfer to the computer **10** can take place at any time following the image capture, without being synchronized to the sensor readout.

What is claimed is:

1. An electronic camera system comprising:

a computer having a card interface slot of the type used for communicating with a removable card containing a semiconductor memory, wherein the card interface slot includes an internal connector;

a camera including means for converting an image into an electrical signal, means for converting the electrical signal into a digital signal, and interfacing means for interfacing the digital signal to the internal connector of the card interface slot of the computer;

wherein the interfacing means includes a structural element that fits into the card interface slot of the computer, and physically connects to the internal connector to provide a link for transferring the digital signal from the camera to the computer; and wherein the card interface slot is a PCMCIA interface slot wherein said image converting means and said signal coverting means are contained within an enclosure, and wherein said interfacing means further includes a cable for connecting said structural element to said enclosure.

2. A camera system as claimed in claim **1** wherein the computer is portable and the structural element connects the computer an camera together as a hand-held unit.

3. An electronic camera for operation with a computer having a card slot for interfacing with a removable memory card, said camera comprising:

an optical system for forming an image of a scene;

an image sensor for converting the image into an electrical signal;

an A/D converter for generating a digital signal from the electrical signal;

a signal processor for generating a processed digital signal from the digital signal; and

an adaptor for conveying the processed digital signal through the card slot to the computer;

wherein the adaptor includes an extender board dimensioned to fit into the card slot of the computer and a connector for physically connecting the adaptor to the card slot, wherein the adaptor provides a link for transferring the processed digital signal from the camera to the computer, wherein the card slot and said adaptor use a PCMCIA standard electrical interface specification and wherein said image converting means and said signal converting means are contained within an enclosure, and wherein said interfacing means further includes a cable for connecting said structural element to said enclosure.

4. An electronic camera as claimed in claim **3** wherein said signal processor provides gamma correction and/or white balancing.

5. An electronic camera as claimed in claim **3** wherein said signal processor is a look-up memory having a transfer function that provides gamma correction and/or white balancing.

6. An electronic camera as claimed in claim **5** wherein said look-up memory also stores information concerning the camera, such as the camera serial number, or a sensor defect map.

7. An electronic camera as claimed in claim **6** wherein said look-up table contains software utilizable by the computer for processing the images.

8. An electronic camera as claimed in claim **3** wherein said extender board supports the camera against a side of the computer having the card slot.

9. An electronic camera as claimed in claim **3** wherein said extender board is removable from the camera.

10. An electronic camera as claimed in claim **3** wherein said extender board may be folded along a side of the camera.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 5,475,441
DATED : December 12, 1995
INVENTOR(S) : K Parulski, et al

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 7, line 26	after "connector;" please insert --and--.
Column 7, line 34,	after "puter", delete ",".
Column 7, line 36	after "computer", please delete "; and" and substitute --,--.
Column 7, line 37	Insert --,-- after "slot" (second occurrence) --
Column 8, line18	After "specification", delete "and".
Colunn 8, line 18	Delete "converting means" and subsitute with --sensor--.
Column 8, line 19	Delete "signal converting means" and substitute with --A/D converter--.
Column 8, line 20	Delete "interfacing means" and substitute with --adaptor--.
Column 8, lines 21 & 22	Delete "structural element" and substitute with --extender board--.

Signed and Sealed this

Sixteenth Day of March, 1999

Attest:

Attesting Officer

Q. TODD DICKINSON

Acting Commissioner of Patents and Trademarks

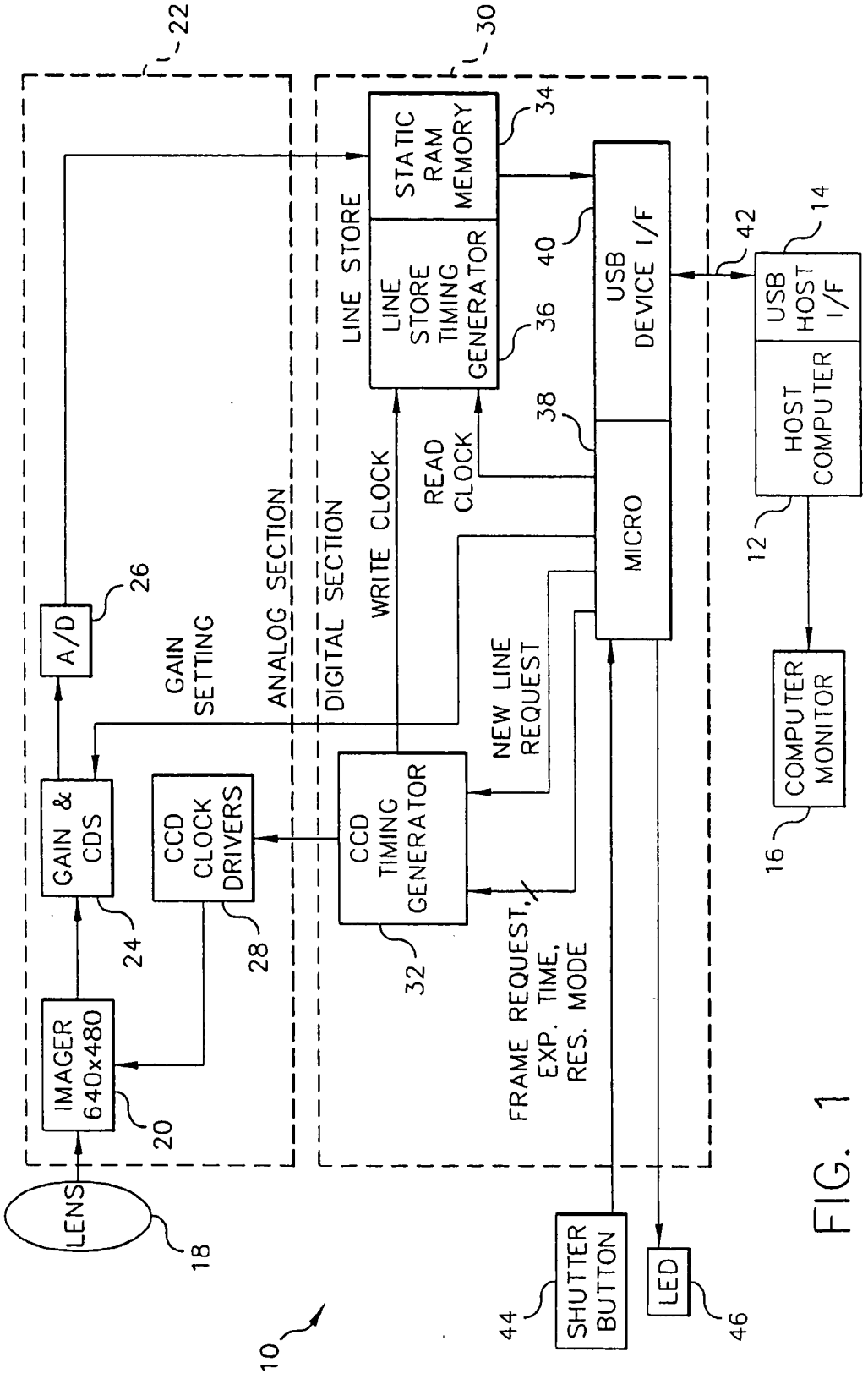

22
30
STATIC RAM MEMORY
34
LINE STORE
LINE STORE TIMING GENERATOR
36
40
USB DEVICE I/F
42
USB HOST I/F
14
HOST COMPUTER
12
COMPUTER MONITOR
16
A/D
26
GAIN SETTING
ANALOG SECTION
DIGITAL SECTION
WRITE CLOCK
READ CLOCK
38
MICRO
NEW LINE REQUEST
GAIN & CDS
24
CCD CLOCK DRIVERS
28
CCD TIMING GENERATOR
32
FRAME REQUEST, EXP. TIME, RES. MODE
IMAGER 640x480
20
LENS
18
SHUTTER BUTTON
44
LED
46
10

FIG. 1

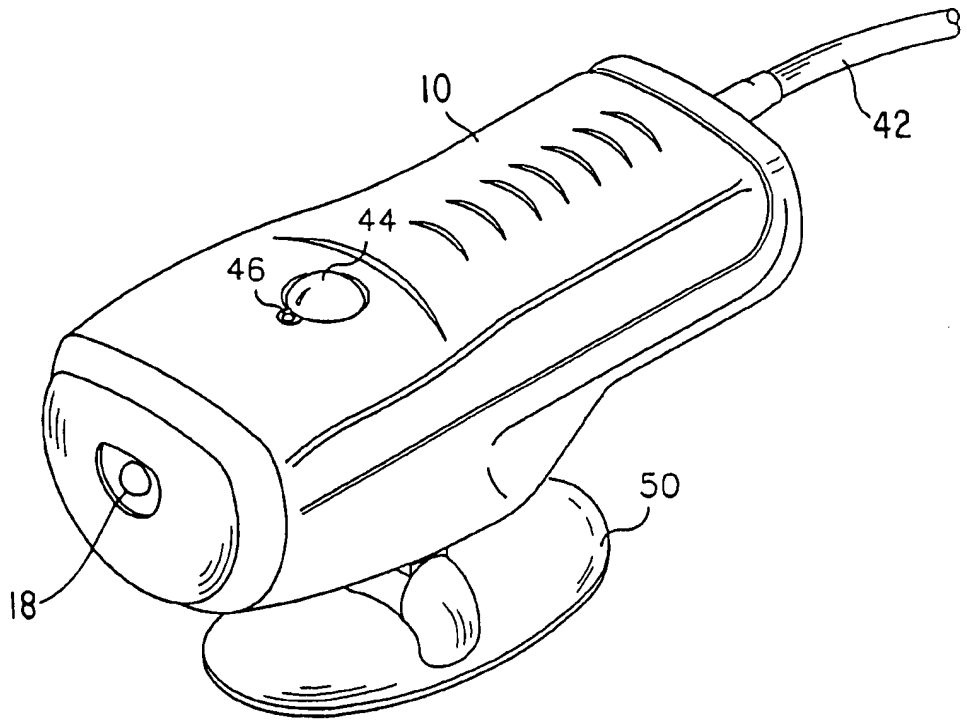


FIG. 2

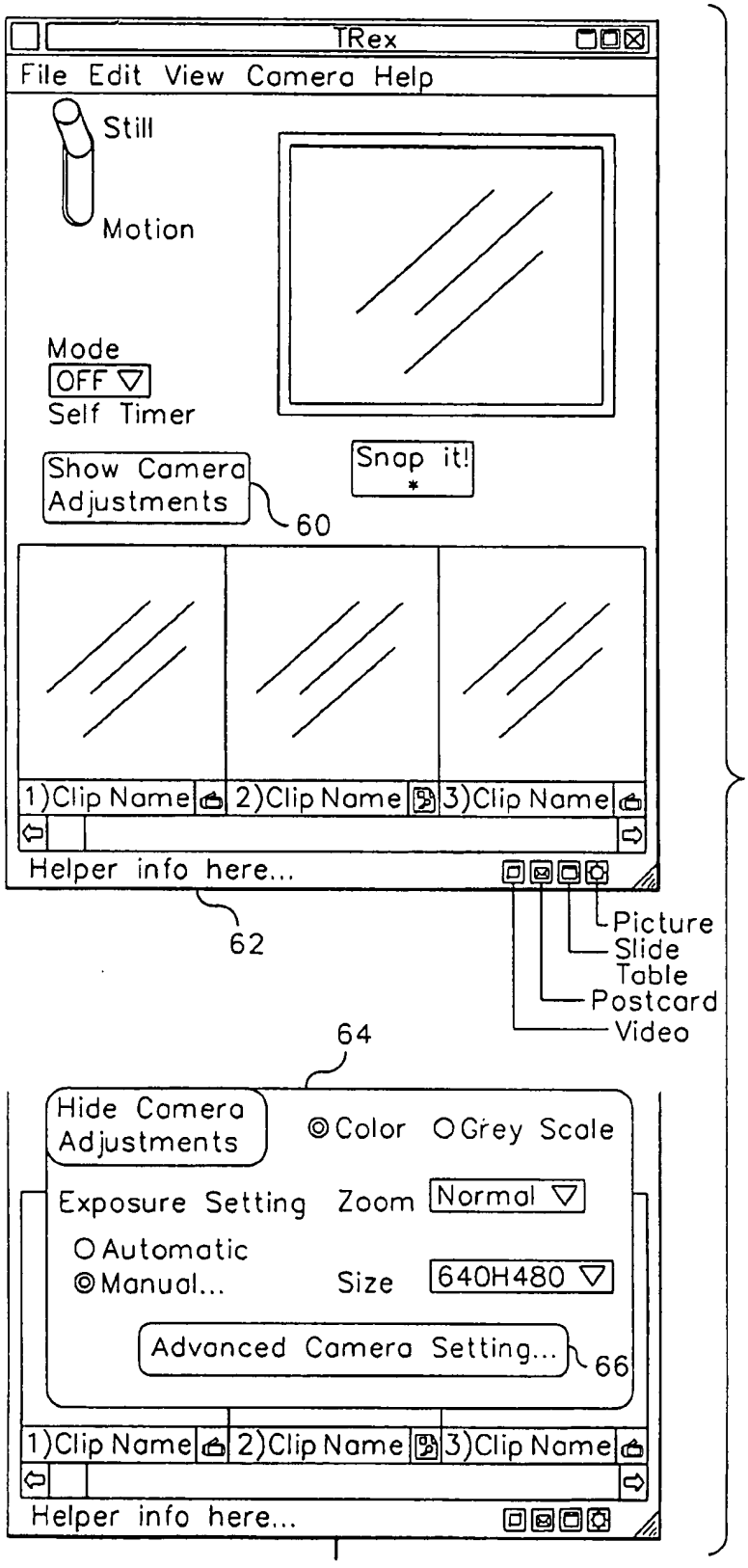


FIG. 3A

FIG. 3B

FIG. 3

FIG. 3A

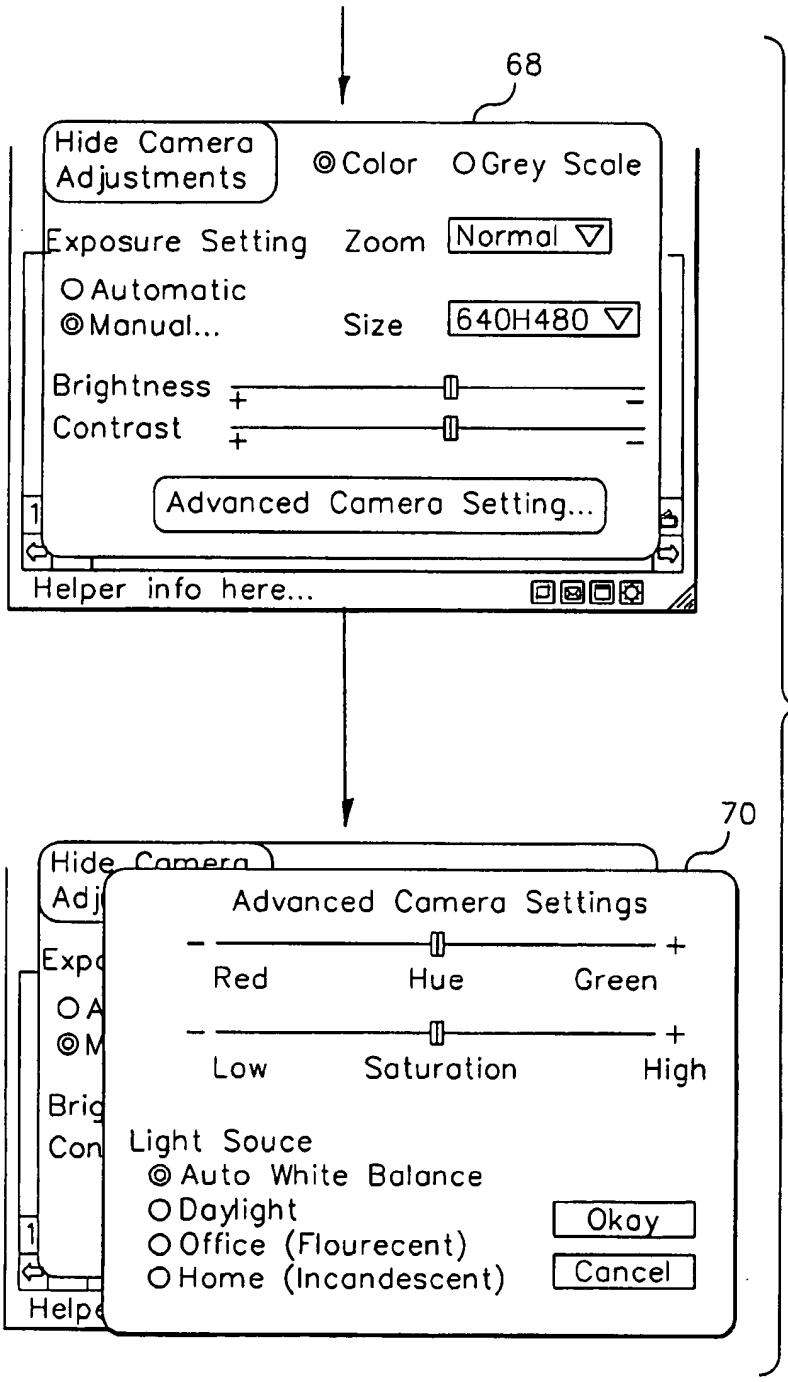

68
Hide Camera Adjustments
Color
Grey Scale
Exposure Setting
Zoom
Normal
Automatic
Manual...
Size
640H480
Brightness
Contrast
Advanced Camera Setting...
Helper info here...
70
Advanced Camera Settings
Red
Hue
Green
Low
Saturation
High
Light Souce
Auto White Balance
Daylight
Office (Flourecent)
Home (Incandescent)
Okay
Cancel

FIG. 3B

MULTI-MODE DIGITAL CAMERA WITH COMPUTER INTERFACE USING DATA PACKETS COMBINING IMAGE AND MODE DATA

FIELD OF THE INVENTION

The invention relates generally to the field of electronic photography, and in particular to a digital camera capable of interfacing with a computer.

BACKGROUND OF THE INVENTION

There are generally two types of electronic cameras, those that produce motion images and those that produce still images. Typical motion cameras include motion video cameras and computer-connected cameras like the Color QuickCam™ camera sold by the Connectix Corporation, and typical still cameras include the Kodak line of digital cameras, including the DC40 and DC50 cameras sold by the Eastman Kodak Company. With motion video cameras, it is typical to input images to a computer via a "frame grabber" board. In this case still images and motion images are captured using a single field or frame of the video. Therefore, the processing for motion and still images, performed in hardware inside the camera, is the same whether still or motion images are captured.

With electronic still cameras, the output processing is typically oriented toward still images, since still image capture is the object of the camera. U.S. Pat. No. 5,402,170, entitled "Hand-manipulated Electronic Camera Tethered to a Personal Computer", describes a digital still camera tethered to a computer for capturing an image and providing the captured image to the computer for storage therewith. Capture of images can be initiated from the camera, but its shutter button, which is controlled pursuant to a status signal from the computer, is used only to initiate the capture of still images.

If the electronic still camera provides another mode, it is typically subsidiary to the main purpose. For example, in U.S. Ser. No. 08/367,399, filed Dec. 30, 1994 (entitled "Electronic Camera Having Dual Modes for Composing and Capturing Still Images" and assigned to the same assignee as the present invention), an electronic still camera is described in which a motion mode is used to provide a "preview" image on an LCD viewfinder prior to still mode capture. The camera does not output the motion image data, but simply displays the motion data on the LCD display. Being part of its fixed signal processing, the camera does not allow the user to affirmatively elect between the motion and the still mode.

U.S. Pat. No. 5,301,244, entitled "Computer Input Scanner Incorporating Multiple Scanning Modes", describes a film scanner useful as an input device for a computer. The film scanner is operable in two modes: the first mode is a low resolution monochrome prescanning mode used for composing (zooming and cropping) the image, and the second is a high-resolution color sequential mode in which three successive high resolution color scans are obtained. Two user-controlled switch functions on the scanner are used: one to continuously capture low resolution frames in the prescan mode, and the second to initiate a high-resolution scan. These switch functions, however, always perform the same task, that is, either to initiate prescan or to capture a high resolution image.

While describing two modes of operation in some cases, the prior art does not allow flexibility in user selection of these modes, or in the communication of mode information between a host computer and the camera. As a result, the functionality of user-controlled switches, e.g., the shutter button, remains fixed.

SUMMARY OF THE INVENTION

The present invention is directed to overcoming one or more of the problems set forth above. Briefly summarized, according to one aspect of the present invention, a digital camera, which captures images and transfers the captured images to a host computer, includes an image sensor exposed to image light for capturing the images and generating image signals; an A/D converter for converting the image signals into digitized image data; a digital interface for transferring the digitized image data to the host computer; means for controlling the image sensor in at least two different camera configurations, each configuration including configuration information defining a plurality of camera parameters; and means for communicating at least part of the configuration information along with the digitized image data to the computer via the digital interface.

By providing two or more configurations that are immediately accessible to the camera, and which can be set from the host computer, the flexibility of the camera is increased. For example, the camera may be configured for capturing still and motion images with a "shutter" button that is used for different purposes in the different configurations. In one case, pressing the shutter button changes the camera from the motion mode to immediately capture a still image. In a second case, pressing the shutter button keeps the camera in motion mode, but enables the recording of a motion sequence in the computer hard drive memory. It does so by sending a code along with the image to indicate that the button has been pressed, thereby triggering the storage of the image sequence on the computer's disk. When the button is pressed a second time, this indicates to the computer to stop the storage process. The digital camera output data includes both the digital image data and a "configuration code" that indicates which of the two configurations was used for the image data presently being output by the camera. This indicates to the host how to process the image data, whether to store the image data, and/or simply display the image data. It also provides a "sync code" that allows the computer to detect data dropouts and resync the video stream by dropping a frame.

These and other aspects, objects, features and advantages of the present invention will be more clearly understood and appreciated from a review of the following detailed description of the preferred embodiments and appended claims, and by reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram of a multi-mode digital camera with a computer interface according to the invention.

FIG. **2** is a drawing of the camera encasement for the camera shown in FIG. **1**.

FIG. **3** shows illustrations of computer screens used as a camera user interface for the camera shown in FIG. **1**.

DETAILED DESCRIPTION OF THE INVENTION

Because imaging devices employing electronic sensors are well known, the present description will be directed in particular to elements forming part of, or cooperating more directly with, apparatus in accordance with the present invention. Elements not specifically shown or described

herein may be selected from those known in the art. Certain aspects of the embodiments to be described may be provided in software. Given the system as described in the following materials, all such software implementation needed for practice of the invention is conventional and within the ordinary skill in such arts.

A block diagram of a multi-mode digital camera with computer interface according to the invention is shown in FIG. 1. The camera **10** is connected to a host computer **12** via a USB (universal serial bus) digital host interface **14**, which also provides power to the camera **10**. USB is a well-known shared bus that can be connected to other devices, such as keyboards, printers, etc. (USB is described in the *Universal Serial Bus Specification,* 1.0 Final Draft Revision, Nov. 13, 1995, which can also be viewed on the Web at http://www.teleport.com/-USB.) The camera **10** can acquire both still and motion images. The camera data is processed by the host computer **12** to create final images that can be displayed on a computer monitor **16**, e.g., transmitted along with audio as part of a "computer videoconference", etc. The camera **10** can produce both high quality (i.e., high resolution) still images and high frame rate, reduced resolution motion images.

The camera **10** includes an optical section **18** for imaging light from a subject upon an electronic image sensor **20**. A preferred image sensor is a Kodak KAI-0320CM interline transfer, progressive-scan charge-coupled-device (CCD) image sensor with a usable active image area having 640 columns and 480 rows of color photoelements arranged in the well-known Bayer color filter array pattern (see U.S. Pat. No. 3,971,065 for a description of the Bayer pattern). An analog section **22** in the camera **10** includes the sensor **20**, a CDS/gain block **24** for performing correlated double sampling (CDS) and setting the analog gain, an analog-to-digital (A/D) converter **26** for converting the analog output signal from the CCD sensor **20** to ,e.g., an 8-bit digital signal, and CCD clock drivers **28** for clocking the sensor **20**. A digital section **30** includes a CCD timing generator **32**, a static RAM memory **34**, a line store timing generator **36**, a microprocessor **38**, and a USB device interface **40**. The USB device interface **40** connects to the USB host interface **14** by means of a USB cable **42**.

The sensor **20** is controlled by the timing generator **32** via the CCD clock driver **28**. The digital data from the sensor **20** is temporarily stored in the static RAM memory **34**, preferably a 64K bit static RAM memory (for example part number IDT7164 made by Integrated Device Technology, Inc.) which is controlled by a line store timing generator **36** so as to serve as a line store. Besides controlling the sensor **20**, the CCD timing generator **32** also controls the line store write clock applied to the line store timing generator **36**. The output of the line store memory **34** is connected to the host computer **12** via the USB device interface **40**, which operates at a maximum data rate of 12 M bits/sec. (See the article "Universal Serial Bus to Simplify PC I/O", by Michael Slater in *Microprocessor Report,* Volume 9, Number 5, Apr. 17, 1995 for more detail about the benefits of the USB interface.) The microprocessor **38**, which may be the Intel 82930 microprocessor, reads data from the line store **34**, and transfers the data to the computer **12** via the USB interface **40** (which may be incorporated as part of the microprocessor **38**). The USB cable **42** includes four wires, one pair for sending data to and from the host computer **12**, and a second pair for supplying power to the camera **10** from the host computer **12**.

As generally used, the USB interface has a clock rate of 12 MHz. The clock is transmitted encoded along with the differential data, and the data is transferred in packets. A SYNC field precedes each data packet to allow the receiver (s) to synchronize their bit recovery clocks. The basic unit of scheduling is 1 mSec. All bus transactions involve the transmission of up to three packets, which include from 1 to 1024 bytes of data plus a 3 bytes header that includes an error detection code word. Each transaction begins when the host computer **12**, on a scheduled basis, sends a USB packet describing the type and direction of transaction, the USB device address, and endpoint number. This packet is referred to as the Token Packet. The USB device that is addressed, e.g., the camera **10**, selects itself by decoding the appropriate address fields. In a given transaction, data is transferred either from the host to a device or from a device to the host. The direction of data transfer is specified in the token packet. The source of the transaction then sends a Data Packet or indicates it has no data to transfer. The destination in general responds with a Handshake Packet indicating whether the transfer was successful.

The USB data transfer model between a source or destination on the host and an endpoint on a device is an abstraction referred to as a "pipe". There are two types of pipes: stream and message. Stream pipes are always unidirectional in their communication flow. Stream data has no USB defined structure while message data does. Additionally, pipes have associations of data bandwidth, transfer service type, and endpoint characteristics like directionality and buffer sizes. Pipes come into existence when a USB device is configured. USB bandwidth is allocated among pipes. Multiple stream mode pipes can be serviced at different intervals and with packets of different sizes.

USB supports two types of pipes, "isochronous" (which guarantees a continuous data stream using a subset of the USB data rate) and "asynchronous" (which transfers blocks of data but may incur a delay before the transfer can begin). The camera USB interface has one pipe for transporting control data to the camera and another for transporting image data from the camera. The latter pipe is a "stream" pipe that can use either "bulk" data transfer mode (asynchronous) or isochronous (streaming real time data transfer) mode which occupies a prenegotiated amount of USB bandwidth with a prenegotiated delivery latency. The USB allocates bandwidth for isochronous pipes when the pipe is established. Bulk and Isochronous mode pipes are stream pipes that deliver data in the data packet portion of bus transactions with no USB required structure on the data content.

The camera **10**, as shown in FIG. **1**, also includes a shutter button **44** for initiating an image capture sequence and a light emitting diode (LED) **46** for indicating operation of the camera during the capture sequence (i.e., to indicate that the camera is taking a picture). A drawing of the camera encasement is shown in FIG. **2**. The camera **10** includes a detachable stand **50** which can be placed on top of the computer monitor **16** for "hands-free" operation. The camera **10** can also be removed from the stand **50** and used for "hand-held" operation. The encasement of the camera **10** shows the shutter button **44** and the LED indicator light **46**, which is useful for the "hand-held" mode.

The host computer **12** controls the camera picture-taking process by instructing the camera **10** when to take still or motion pictures, and setting the electronic exposure time and the analog gain in the CDS/gain block **24** via the microprocessor **38**. The USB hardware and software provides communication between the host **12** and the camera **10** through the aforementioned abstraction called a "pipe". When the camera **10** is connected to the host **12**, camera driver

software running on the host **12** indicates the latency and bandwidth required for the camera.

The operational modes of the camera **10** can be adjusted from the host computer **12**. More particularly, the microprocessor **38** includes camera registers **72** that store at least two different camera configurations communicated from the host computer **12** for controlling the image sensor in at least two modes, wherein each configuration includes information defining a plurality of camera parameters as shown in the first column of Table 1. As further shown in the second column of Table 1, the parameters may assume a number of allowed values that are appropriate for either motion (continuous) or still (single shot) modes.

TABLE 1

Camera configuration parameters

Parameter	Allowed values
Capture mode	Continuous or single-shot
Button mode	Enabled or disabled
Link field	Configuration 0, configuration 1, stop
Color mode	Color or monochrome
Number of bits per sample	8 or 4
Crop values	Starting line #, Ending line #
	Starting pixel #, Ending pixel #
Green horizontal subsampling factor	1, 1/2, 1/4 (320, 160, or 80 pixels max.)
Green vertical subsampling factor	1, 1/2, 1/4, 1/8 (480, 240, 120, or 60 lines max.)
Red/Blue horizontal subsampling factor	1, 1/2, 1/4, 1/8 (320, 160, 80, or 40 pixels max.)
Red/Blue vertical subsampling factor	1, 1/2, 1/4, 1/8 (240, 120, 60, or 30 pixels max.)
Integration time	1 msec to 100 msec
Analog gain	1–7 unit adjustments

Many of these parameters are particularly useful in the continuous (motion video) capture mode, in order to provide a higher video frame rate, and in determining how the camera moves from one configuration to the other. For example, the camera **10** is configured by input from the host computer **12** by specifying the values of the group of parameters shown in Table 1, as follows. (1) From the "color" mode parameter, either a color image is selected, thereby causing the camera to transfer RGB images, or a monochrome image is selected by specifying the "monochrome" value, thereby causing the camera to transfer only the green data. (2) By means of the crop value parameter, the selected starting and ending lines and pixels may be used to "crop" the image before it is transferred, thereby further reducing the amount of data that has to be sent to the computer **12**. This also has the effect of acting as a "digital zoom", and can be presented on screen as either a smaller image than the non-cropped original, or as a "zoomed in" version of the original. (3) By specifying the horizontal and vertical subsampling factors (to be other than the allowed value of 1), the desired color plane (Red, Green, and Blue) is accordingly subsampled as the data is stored into the line store **34**. Since the Bayer color filter pattern is a mosaic of separate colors, the number of pixels obtained by use of each subsampling factor corresponds to a fraction of the number of red, green, and blue pixels in the pattern. (4) By specifying the number of bits per sample, it is possible to select different color depths (all 8 bits/color vs. using only 4 bits/color) as the data is read from the line store **34** and transferred over the USB interface **40**. (5) The exposure of each image is determined by the integration time and gain setting of the corresponding configuration, i.e., taken together these parameters make up the exposure.

The button mode parameter determines whether the shutter button **44** is enabled or disabled. When the shutter button is disabled, pressing the button does not change the mode. However, the camera conveys the button status (pressed or not pressed) to the computer, and this can be useful (as will be described) in instructing the computer to save all the images transmitted or not. When the shutter button is enabled, pressing the button causes the camera to automatically shift to the other configuration stored in the camera registers **72**, i.e., if presently in configuration **0**, then the camera shifts to configuration **1** or if presently in configuration **1**, then the camera shifts to configuration **0**. The link field parameter determines which configuration will be used to capture the next image frame. For example, if the camera is in configuration **0** and the link field is also configuration **0**, the camera will examine the link field after capturing each frame and see that it should always return to the same configuration. Thus, the camera will continue to take pictures in configuration **0** until the shutter button is pressed. This is the typical operational sequence for the motion or continuous capture mode. On the other hand, if the camera is currently in configuration **0** and the other configuration stored in the camera registers **72** is configuration **1** with a link field of **0**, when the shutter button is pushed the camera shifts from configuration **0** to configuration **1**, takes one frame, looks at the new link field (which is **0**), and shifts back to configuration **0**. This is the typical operational sequence for a still capture. The "stops" value in the link field parameter idles the camera such that it is not producing pictures. This can be useful in shutting the camera down, e.g., after taking a still image until the shutter button is again pressed, which restarts the motion mode.

As set forth in Table 1, the parameters include allowed values appropriate for two different camera configurations: therein called camera configuration **0** and camera configuration **1**. Table 2 shows a specific selection from the allowed values, wherein configuration **0** is a low resolution continuous (motion) configuration and configuration **1** is a full resolution single-shot (still) configuration. When the camera is first powered up, default values are stored such as those shown in the first column of Table 2 for the continuous capture mode and in the second column for the single-shot capture mode. Since the continuous mode (configuration **0**) is used first and the link field is set to configuration **0**, the camera **10** begins sending a series of color motion images, each with 320×240 green pixels and 160×120 each red and blue pixels per image, with 4 bits per color. This allows a frame rate of over 10 frames per second at a data transfer rate of 5 Mbits per second. The user can hold the camera while viewing the computer monitor display **16** to create a motion sequence for videoconferencing, or in order to frame a person, object, or document to be captured. When the user presses the shutter button **44**, the camera immediately moves to the single-shot mode and uses the parameters from configuration **1**, which in this example captures a color image with 320×480 green pixels and 320×240 red and blue pixels, with 8 bits per color. Since the link field parameter is set to configuration **0**, a still is captured and the camera immediately shifts back to configuration **0**, the continuous mode. Because the parameters for the two configurations are programmed by the computer but stored in the camera mode registers **72**, the desired type of image can be immediately captured when the shutter button **44** is pushed, without waiting for additional communications between the host computer **12** and the camera **10**.

TABLE 2

An example of camera configuration parameters for motion to still capture

	Configuration 0 value	Configuration 1 value
Capture mode	Continuous	Single-shot
Button press mode	Enabled	Enabled
Link field	Configuration 0	Configuration 0
Color mode	Color	Color
Number of bits per sample	4	8
Crop values	Starting line = 1, Ending line = 480 Starting pixel = 1, Ending pixel = 640	Starting line = 1, Ending line = 480 Starting pixels = 1, Ending pixel = 640
Green horizontal subsampling factor	1 (320 pixels)	1 (320 pixels)
Green vertical subsampling	1/2 (240 lines)	1 (480 lines)
Red and Blue horizontal subsampling factor	1/2 (160 pixels)	1 (320 pixels)
Red and Blue vertical subsampling factor	1/2 (120 lines)	1 (240 lines)
Integration time	30 msec	100 msec
Analog gain	7	2

Alternately, instead of using the default parameters for configurations **0** and **1** as shown in Table 2, the user can chose preferred parameter values using the user interface screens shown in FIG. **3**, which appear on the computer monitor **16** when the user interface is enabled. More specifically, the user clicks on a "camera adjustments" icon **60** on a basic screen **62** in order to pull down a camera adjustments screen **64**. By then clicking on an "advanced camera settings" icon **66**, an advanced camera settings screen **68** is obtained, and so on through as many additional screens **70** as are needed. The computer would take the user settings and translate them into the appropriate configuration settings for the camera, e.g., the zoom setting would be translated into the crop windows. In this manner, the camera configurations may be customized for the specific application.

For example, Table 3 shows a customized selection from the allowed values, wherein configuration **0** is a low resolution continuous (motion) monochrome configuration and configuration **1** is a low resolution continuous (motion) color configuration. When the camera is powered up, the continuous monochrome mode (configuration **0**) is used first and the link field is set to configuration **0**. The camera **10** thus begins sending a series of monochrome motion images, each with 320x240 green pixels, with 4 bits per pixel. This would allow a frame rate of approximately two times the frame rate of a similar resolution color image stream. The user can hold the camera while viewing the computer monitor display **16** to create a motion sequence for videoconferencing, or in order to frame a person, object, or document to be captured. When the user presses the shutter button **44**, the camera immediately moves to the color motion mode and uses the parameters from configuration **1**, which in this example captures a color image with 320x240 green pixels and 160x120 red and blue pixels, with 4 bits per color. Since the link field parameter is set to configuration **1**, the camera begins sending a series of color images in the continuous mode. Because the parameters for the two configurations are programmed by the computer but stored in the camera mode registers **72**, the desired type of motion sequence can be immediately captured when the shutter button **44** is pushed, without waiting for additional communications between the host computer **12** and the camera **10**. When the user presses the shutter button a second time, the camera reverts back to configuration **0** operation and storage of the video stream is terminated.

TABLE 3

An example of camera configuration parameters for monochrome motion to color motion capture

	Configuration 0 value	Configuration 1 value
Capture mode	Continuous	continuous
Button press mode	Enabled	Enabled
Link field	Configuration 0	Configuration 1
Color mode	Monochrome	Color
Number of bits per sample	4	4
Crop values	Starting line = 1 Ending line = 480 Starting pixel = 1, Ending pixel = 640	Starting line = 1, Ending line = 480 Starting pixels = 1, Ending pixel = 640
Green horizontal subsampling factor	1 (320 pixels)	1 (320 pixels)
Green vertical subsampling	1/2 (240 lines)	1 (240 lines)
Red and Blue horizontal subsampling factor		1 (160 pixels)
Red and Blue vertical subsampling factor		1 (120 lines)
Integration time	30 msec	30 msec
Analog gain	7	7

Other combinations of configurations can be readily implemented. For example, configuration **0** (link field **0**) could be a low resolution motion mode (by use of the subsampling factors) and configuration **1** (link field **1**) could be high resolution mode. The shutter button would be used to toggle between the two odes. Another example would use configuration **0** (link field **0**) as a full resolution image and configuration **1** (link field **1**) as a cropped image (by appropriate use of cropped values). Then the shutter button would be used to toggle between a "conventional" image and a "zoomed" image. Many other combinations are possible, e.g., high resolution color to low resolution color, moderate subsampling to significant subsampling, low resolution color motion to high resolution monochrome still, and so on. Since the shutter button is used as a toggle to move between configurations, it takes on a multiplicity of functions. (Note that not all combinations need be exposed to the end user.)

The image data is transmitted to the host computer **12** via packets of information, which may be 64 bytes per packet when the USB "bulk" transfer mode is used. The first packet of data at the beginning of each new frame includes the configuration and status information shown in Table 4. The header begins with a 4 byte "Sync word" (1) that identifies the image frame number, followed by a value (2) that indicates how many bytes of image data are contained in the frame. The color mode and number of bits per sample (3), cropping values (4), and subsampling factors (5) provide the aforementioned configuration values. The button status (6) indicates whether or not the user is currently pressing the shutter button. (Note that this status is independent of the button press mode shown in Tables 1, 2, and 3). Following the image header, packets containing the image data are transmitted. The number of packets per frame depends on the camera configuration.

TABLE 4

Frame header configuration and status information

	Name	Bytes
1	Sync word	4
2	Number of image data bytes in packet	4
3	Color mode and number of bits per sample	2
4	Cropping values	8
5	Green and Red/Blue horizontal and vertical subsampling factors	2
6	Button status	1

Including the configuration information and camera status information in the data packets sent to the computer **12** has the following advantages:

- The button status value (6) is used to control whether or not the image data is stored in the computer memory, typically using the computer's hard drive. For example, in some still modes it indicates that the still image should be stored, and in some continuous modes it indicates that the sequence of motion images captured when the button is depressed would be recorded as a "movie" sequence.
- The sync word is used to indicate which image frame the data is from, since each image is transferred using numerous data packets. If a data packet from the "next" frame is received by the computer before all of the data from the "current" frame is received, the computer will know that one of the packets for the current frame has been "dropped". In this case, the "old" frame will be repeated, and the current frame will not be displayed. The computer will then begin building the next frame, and re-sync with the display/storage stream at the appropriate time.
- The configuration information can be used by the computer to ensure that the image processing path is correctly set.

The invention has been described with reference to a preferred embodiment. However, it will be appreciated that variations and modifications can be effected by a person of ordinary skill in the art without departing from the scope of the invention.

PARTS LIST

10 digital camera
12 host computer
14 USB digital host interface
16 computer monitor
18 optical section
20 electronic image sensor
22 analog section
24 CDS/gain block
26 A/D converter
28 CCD clock drivers
30 digital section
32 CCD timing generator
34 static RAM memory (line store)
36 line store timing generator
38 microprocessor
40 USB device interface
42 USB cable
44 shutter button
46 LED
50 detachable stand
60 camera adjustment icon
62 basic screen
64 camera adjustments screen
66 advanced camera settings icon
68 advanced camera settings screens
70 additional screen
72 camera mode registers

What is claimed is:

1. A digital camera for capturing images and transferring the captured images to a host computer, said camera comprising:

an image sensor exposed to image light for capturing the images and generating image signals;

an A/D converter for converting the image signals into digitized image data;

a digital interface for transferring the digitized image data to the host computer;

means for controlling the image sensor in at least two different camera configurations, each configuration including configuration information defining a plurality of camera parameters;

means for storing the camera configuration information defining the plurality of camera parameters for the at least two different camera configurations;

means for selecting a camera configuration; and

means for communicating at least part of the selected configuration information from the storage means along with the digitized image data to the computer via the digital interface.

2. The camera as claimed in claim **1** wherein the digital interface is a Universal Serial Bus (USB) interface.

3. The camera as claimed in claim **1** wherein said at least two different configurations comprise separate modes for still and motion readout of the sensor.

4. The camera as claimed in claim **1** wherein said at least two different configurations comprise separate modes for motion readout of the sensor.

5. The camera as claimed in claim **3** wherein, in the motion readout mode, the sensor does not transfer all of the sensor image data to the digital interface.

6. The camera as claimed in claim **1** wherein the configuration information includes at least one of a color mode, a subsampling factor, a number of bits per sample, and a cropping factor.

7. A digital camera for capturing images and transferring the captured images to a host computer, said camera comprising:

an image sensor exposed to image light for capturing the images and generating image signals;

an A/D converter for converting the image signals into digitized image data;

a digital interface for transferring the digitized image data to the host computer;

a memory for storing configuration information defining camera parameters for at least two different camera configurations, each configuration including camera parameters that apply to a current image and a linkage parameter that indicates which configuration to apply to a next image; and

means for controlling the image sensor in a selected one of said at least two different camera configurations

according to the configuration information that applies to the current image, wherein the controlling means is further responsive to the linkage parameter in the selected configuration to determine which configuration to apply to the next image.

8. The camera as claimed in claim 7 wherein a first value of the linkage parameter requires staying in the same configuration and a second value of the linkage parameter requires moving to another configuration.

9. The camera as claimed in claim 8 wherein the first value of the linkage parameter corresponds to capturing a sequence of continuous images in a first configuration and a second value of the linkage parameter corresponds to capturing a still image before moving to said another configuration.

10. The camera as claimed in claim 9 wherein moving to another configuration, as required by the second value of the linkage parameter, comprises moving back to the first configuration.

11. A digital camera for capturing images and transferring the captured images to a host computer, said camera comprising:

an image sensor exposed to image light for capturing the images and generating image signals;

an A/D converter for converting the image signals into digitized image data;

a digital interface for transferring the digitized image data to the host computer;

a memory for storing configuration information defining camera parameters for at least two different camera configurations, the configuration information including a linking parameter that indicates that the digital camera should shift to a second configuration after a capture is initiated in a first configuration;

a timing generator for controlling the image sensor in said at least two different camera configurations according to the configuration information defining the camera parameters, wherein the timing generator is responsive to the linking parameter to control the image sensor in the second configuration; and

means for communicating at least some of the configuration information stored in the memory from the camera to the computer via the digital interface.

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